Amateur Radio

73 Magazine

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73 Magazine

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Editor, etcetera

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Cover: Wayne Peirce K3SUK, who, by the way, also did the December cover.

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INCENTIVE LICENSING

I am upset. I am upset over the idea of incentive licensing. I know, as I watch the government going into more and more businesses and controlling more and more things tighter and tighter, that I am opposing a relentless force. I still feel like speaking out when someone wants to get something done and their first turn is to the government. What has happened to free enterprise?

The case in point is the ARRL's petitioning of the FCC to force the amateur to study more radio theory in order to hold on to his present privileges. If the ARRL feels that the amateurs should spend more time learning theory why didn't they at least make even a slight attempt to talk the amateurs into this idea and lead them in that direction? Why, without even a try at getting hams to learn, did they turn immediately to the government and petition them to force everyone to do what the ARRL wanted?

Is government force the only "incentive" that will work? Shades of Russia.

If I am wrong and it actually is impossible to get amateurs to voluntarily improve themselves, then I can see some application for incentive licensing. This does not mean that I am not upset over the ARRL proposals. I am very upset over them.

The ARRL says we are going to pot. This is unarguable because there is no possible way to prove a case pro and con. I don't believe we are going to pot. I am distressed and disappointed to see the ARRL and fellows like Bill Orr tearing down our wonderful hobby.

I am upset over the way that the ARRL went about putting in its petition to the FCC. Now that it is in we can see that there never was any intention at any time of asking the membership what they thought. Apparently even the Directors were hoodwinked to a degree too, though this is their own fault for leaving decisions of this magnitude to the League Officials. One Director wrote to me in confidence that *he* was opposed to incentive licensing. Rather than go into detail over this aspect of the petition I recommend that you read the two rebuttals to RM-499 that I've included in this issue. They are both different enough to warrant publication and both make many good points.

I am upset over the actual proposals made by the ARRL. Why was their schedule of taking away phone bands from the great mass of licensees planned to present the worst possible picture of occupancy of our most precious bands just before Geneva Conference time? Why did they decide to have General and Conditional licensees re-examined and yet exclude the Advanced Class licensees? Why did they decide to take away privileges from the great proportion of amateurs rather than offering them additional privileges? Why did they make no provision whatever for incentive for the CW operator? Why was absolutely no announcement of their actual plan made until after it had been submitted to the FCC?

I am upset over the rumors that have been circulating about RM-499. I have had several reports that a major League Official has actually named an FCC official as acting advisor to the ARRL in rigging RM-499. I do not believe that an FCC official would be guilty of such collusion and I think it poor ethics on the part of the ARRL to try to convince amateurs through a strategem of this nature that there is no use in fighting the proposal since it is actually FCC sponsored and therefore will obviously go through. This is a terrible thing to say for it could easily wreck the career of the FCC official involved. I have not the slightest indication from any source (and I have a lot of sources) that the FCC was in any way a party to this proposal or that they look upon it with even the slightest degree of favor. In view of the reported ARRL allegations many of us are watching the FCC procedure with more than the usual interest to see if RM-499 gets any more preferential treatment than, say, RM-399.

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W2NSD/1

never say die

ARRL - RM499 & SUCH

Geneva

The ARRL, after many explanations for their actions, brought up the international situation in their September QST editorial. Better late than never. At least we know that they are thinking about the next Geneva conference, even if they have managed to come up with one of the worst possible solutions to the problems involved. This is a change from the last conference where nothing whatever was done except keep fingers crossed and hope for the best.

I feel very helpless about all this. I can see the situation and I can see some things that should be done about it, but I am so completely tied down to running 73 that I can't do anything about it.

What sort of things would help? Well, first of all I think we have to spread the word about what we face in two to six years at Geneva. The situation as it stands now is a grim one and time is growing short, maybe too short, to turn the tide. We need to get in gear fast and start in doing everything possible to insure the emergence of amateur radio from Geneva with its short wave bands.

The best defense is a good offense. We need the best possible publicity at home and abroad. This means we should have a potent lobby in Washington so that the value of the amateur "service" is well known to all branches of the government and Congress. I feel that an office in Washington is also of great importance as a liason between the many government agencies which have questions or problems re-ating to amateurs and ourselves.

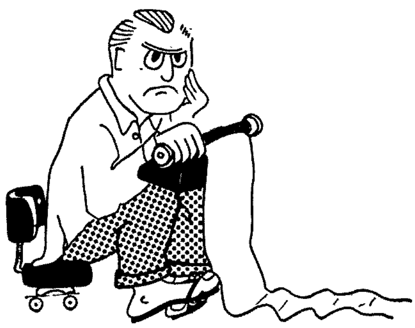
On the international scene we should work with the amateurs in foreign countries to prove o their governments the many advantages of a strong amateur service. By convincing them o pattern their rules after our own FCC regu-ations we will be able to bring about a sharp ise in amateur radio in many areas of the orld. An understanding of the benefits of mateur radio and a strong constituentcy in oreign countries will help us tremendously hen the question of frequencies is discussed t Geneva.

We should be able to send a small group (perhaps three) of mature and experienced amateurs to visit the newer countries and help our cause by going to the governments and selling them on the benefits to them of encouraging amateur radio to blossom forth in their country. We should be prepared to help interested men in these countries to get their equipment, to get started and spread the seed of interest. I doubt seriously if we would run into any problems in getting the cooperation of our manufacturers in providing equipment for something like this. I know that thousands of amateurs all over the country would be happy to find some foreign ham that could use some of the gear that is stashed away in the attic, cellar or garage. By setting up such a procedure we could in a few short years cause amateur radio to grow tremendously.

What country is going to send a delegate to Geneva (in all probability a ham) and let him vote for the cutting back of our amateur bands if this will discourage their own citizens from pursuing electronics.

We should start soon on a campaign to eliminate those liddisms which are being made into such a big deal. With just a bit of encouragement and wit I'll bet that we can cure all of the popular complaints. We cured TVI with magazine articles and TVI committees, why not cure lids with articles and Lid Committees? When a Lid Committee runs up against a psycho (and we have 'em), this should be reported to the FCC.

The short wave broadcasters will be sorely distressed to see me bring this up again, but one other important function we could provide



"Amateur Radio Exists Because of the

would be as much discouragement as possible to short wave broadcasters. If we raise an organized fuss every time a short wave station station settles down in a ham band, barrage the responsible government with complaints and tell them that we, all 250,000 of us, will do everything in our power to keep anyone we know from ever going to visit their country or buying any product of their country, I think we can be effective. We can also make them aware of the microscopic short wave listening audience that they have available in this country.

Since the pressure for more frequencies will be on from all fronts one of the most valuable efforts we could undertake would be a spectrum analysis of the short waves. Since we have amateurs everywhere we could organize a world-wide listening program and eventually come up with facts and figures on the actual utilization of the short waves. Anyone who has listened much knows that the amount of productive use of these frequencies is pathetically small. If we could turn up at Geneva with the goods on the other services we would be in a good position to demand a correction of their inefficiency instead of submitting our amateur bands to amputation.

An analysis of this magnitude would be very costly, though I'll bet that we could get one of the computer companies to make time available for the inspection of our data once compiled. We could probably get the loan of the card punchers and other gear too . . . . but we would still need a staff of people to correspond and punch the cards.

The ARRL has been approached on several of these ideas and has turned them down flatly. Where do we turn? The Institute of Amateur Radio is far too small right now to undertake anything of this magnitude.

The ARRL, though it makes a small profit each year and has quite a bundle in the bank, couldn't possibly undertake a program such as I have outlined without a major dues change. Something like this should cost a minimum of $250,000 a year . . . and $500,000 would be more like it. This is precious little to spend at this critical time. How much is it worth to each of us to keep amateur radio going? If 50,000 amateurs put in $10 a year we could do this and do it well.

Ten dollars a year for insurance on your equipment to make sure that you are going to be able to use it in a few years. Peanuts. Ask any sports car owner what it costs to belong to the Sports Car Club of America . . . or any other sports car club. There are few clubs that don't charge more than ten dollars a year in any field of interest or hobby.

One of the best things that could happen would be for the ARRL to cut out this incentive licensing nonsense, increase the League membership dues $10 a year and get to work on all fronts. I would like to see them do it. But I know darned well they won't. There is also a question of how many amateurs would go along with them on something like this after the double-cross they feel they got on incentive licensing. Remember that it was admitted in QST that at least half of the members were opposed to their petition. My estimate would be a lot higher . . . maybe 90%.

Be that as it may, I am tied down to keeping 73 running. I wish that there was some way that I could do something to get the ball rolling with the Institute of Amateur Radio and get started on some of the things that should be done. A few more pages of advertising in 73 would greatly simplify everything here and would take a lot of the pressure off. You can help with this, if you will, by mentioning 73 every time you write to an advertiser and doing everything you can think of to encourage some of the manufacturers and distributors who are not now advertising in 73 to do so. It isn't as if they would be giving to charity for ads in 73 are less than half the cost of ads in QST or CQ and advertiser after advertiser claims that 73 brings excellent results.

Let me know (in letters not requiring answers) what you think. Should I stop worrying about what is going to happen and let things go along without lifting a hand to do what I can? Do you think you can convince the ARRL to get moving? Should we increase the yearly dues of the Institute of Amateur Radio to $10 a year and get things started as best we can? Can you get five other fellows to back you up by becoming members of the Institute? The Institute of Amateur Radio, by the way, is chartered as a non-profit corporation.

Shall we get started?

as a Service Hobby it Provides."

Hobby

The article by Bill Orr in the November issue deserved a bit more attention than the few moments I was able to give it when it came in just before presstime. The Institute of Amateur Radio tour brought me back minutes before the December issue went to press, so I haven't really had a chance to put in my thoughts until right now.

As Bill said, amateur radio does have some serious problems looming ahead of it on the international scene. Certainly every amateur knows that the FCC is able to permit us to operate only in those bands set aside by international agreement for our occupation. If anyone has been reading my editorials for any length of time he knows that our frequencies are coveted by commercial and foreign interests. We came very close to losing significant parts of our choicest bands at Geneva in 1959. Amateurs in Europe and Asia have already lost many of the frequencies that we still are able to use.

This is a time, as Bill says, for evaluation. Let's first take a look at the concept of "service," since Bill says that it is dangerous for us to think of amateur radio as a hobby, but should always think of it in terms of "service." Is it possible that Bill has forgotten all the fun he has had out of amateur radio? Has he forgotten the years he spent DX chasing? The years he spent building equipment? The DXpeditioning, the rag chewing, the experimentation? Has he forgotten that amateur radio has been *fun* for him? Is he trying to say that all this time he has been performing a serious service to his country and nothing else?

Thick poppycock! (Not sheer).

Bill, and the rest of us, have been active in our HOBBY for all these years because it is *fun*. We have enjoyed it. Few of us have ever found another hobby that was *more* fun. But this in no way detracts from the services that we have performed for our communities, our country and for the world. This has not kept us from springing into action at the first hint of trouble to be ready to provide emergency communications (and *enjoying* doing it). This has not kept us from being so enthused about radio that many of us have decided to make it our life's work, thereby benefitting the electronics industry and our country. This did not keep us from joining the armed services in World War II and providing tens of thousands of radio operators and technicians. This made us all the better at these functions because we had, earlier in life, equated radio with fun.

Ham radio is fun. It *has* to be fun if it is to survive. It *has* to be fun if it is to be of service. Take the fun out of ham radio and you will take the operators out . . . and you have *no* service. So let's stop all this semantic nonsense about ham radio having to be a service and not a hobby.

Now, just because ham radio is fun, does that mean that there is no incentive for learning more, for becoming more proficient? This is not true of other hobbies. I've had a lot of them, so I have some perspective on this. How many skin divers don't try constantly to improve their diving ability? How many skiiers don't constantly try harder and harder slopes? How many golfers don't practice, take lessons, and putt every chance they get? Camera bugs spend a lot of time and money on magazines, books, new equipment, practice, and experimenting. Are we any different? CW men work for code proficiency. Judging from the immense lists published in QST and CQ of hams who have made the Honor Roll, DXCC, WAZ, WPX, etc., hams are in there trying to do the best they can too. To get on these lists takes a lot of effort, experience, attention to detail, and darned good equipment. It isn't easy. If you aren't on one of these lists let's see you try and make it. Or how about placing well in one of the big contests? Try and be first in your section in the ARRL Sweepstakes, VHF or DX contests and you'll find out what dedication this takes.

Sure, we've got a few lids with us who can't replace a fuse, but we've always had this sort of excess baggage. Unfortunately those few old timers who couldn't replace fuses now come under the Grandfather Clause and we'll have to put up with them until they expire. Right from my earliest days in ham radio I've known hams who had to have a friend come over every time anything went wrong with their rig. I don't see any signs that the situation is any worse than it ever was.

Bill goes on to point out some popular lid-isms such as "break-break" and "gimme a clear channel for a phone patch" as proof that we're coming apart at the seams. He should read some of the Old Man's stuff in old QST's. The cry of alarm is as loud today as it was thirty years ago and the little collection of lids go happily on.

I don't know where Bill dug up his expert witness for the ham distributors, but we've got one around here who says, "Sure, I've got a few ham customers who can't change a fuse, but the great majority of them are pretty shrewd chaps who read up carefully on a piece of new gear before they invest and give me little trouble once they've bought. I'm constantly amazed at their ability to second guess the factory engineers."

West coast schools are in trouble too. Back here one well-known educator, also a radio amateur, pointed out, "It has been my experience that radio amateurs are almost invariably ahead of their classmates in courses that require understanding rather than just plain memorization. A great many of the truly remarkable science students I've had were licensed amateurs."

A well-known amateur who has been a project director in a large electronics firm had this to say, "Electronics would not be where it is today in this country if it were not for radio amateurs. I defy anyone to show me an electronics company today that does not have a sizeable number of amateurs on their staff."

It must be admitted that the number of amateurs who are building their own transmitters has dropped off considerably since the day of the MOPA rig and the 6L6 modulated by a 6L6 era. Few amateurs today can hope to build a 200V, or even for that matter do a reasonable job of servicing one. It takes a high degree of knowledge and a lot of expensive test equipment to prepare one to tackle something like that. No wonder a lot of modern equipment has to be professionally serviced.

What then is the role of the amateur in today's technology? Is there anything left for the amateur but plugging in his equipment and going on the air? You bet there is. Ham radio holds more today for the amateur than ever before. In the old days you had your choice of phone of CW. Period. Now we have large groups of amateurs who are actively experimenting and operating with RTTY. These chaps have done much to develope new types of equipment to meet the specialized needs of amateur radio, equipment which is very valuable for commercial and military applications.

We have Ham-TV, though there are only a few hundred actively investigating this new frontier of our hobby. We have the VHF's and UHF's, where the great bulk of the present day home construction and experimentation is going on. Remember that the first working parametric amplifier was used on six meters.

Amateur radio in the United States is a hobby and needs apologize to no one. It has more stature than it ever had before. When we look at the FCC rules we find that we are indeed fulfilling our mandate far better than the amateurs of any other country in the world. We have the only really effective amateur "service" in the world. Is there any legitimate question of stature when our government recognizes us to the extraordinary extent of permitting us to orbit our own satellites? PICON? We are the world's leaders when it comes to PICON. The world would do well to take a close look at our amateur radio rules and see where they can make changes which will encourage their people to become enthused about hamming and bring them all of the benefits which we now have.

Fellow amateurs, I say you should be proud. Ignore those few mental defectives who are spreading their inconsideration on our bands. They are insignificant in the large picture of things. They certainly are not just cause for the furor that we have been subjected to. Ask the old timers about ham radio in the 30's. Ask them how much stature it had then as compared to today. Ask them if they had anyone to compare with Arthur Godfrey, Curtis Lemay, and Butch Griswald as active amateurs. There seems to be a good possibility that we may find ourselves with a president who is a ham. Stature?

OK. So we have the best amateur service in the world, something of which we can really be proud. Does this mean that we must leave it as it is and not try to work out ways to improve our hobby and ourselves? Of course not.

Frankly I was greatly disappointed to see Bill selling ham radio short the way he did. I felt that he was extremely unfair when he resorted to selective quotes from anonymous "experts" to prove his contention that amateur radio is at its lowest ebb and that we should all stand head bowed in shame for our sins. I was very disappointed, more to the point, shocked, to find that he was approving of ARRL's proposal for a return to the old Class A licensing system.

Incentive Licensing

The ARRL has thrown a tremendous work load on the FCC by their hasty petitioning for taking the phone bands away from the General and Conditional licensees. The bulk of the hassle could have much better been worked out through the pages of QST and membership contact with the directors. Now the membership (and everyone else) is suddenly faced with an FCC about to act upon proposed legislation. Petitions and letters are going into the FCC at record volume and you can imagine what the effect has been upon the three fellows who make up the Amateur Division, not to mention the impression all this obviously must make on the FCC Commissioners themselves.

The ARRL's proposal has been countered by many others, some of which seem far more reasonable to me. After reading through some twenty different petitions and taking the best ideas out of the best of them, I'd like to throw this possible solution to the matter at hand up for discussion.

Suppose we establish two separate "Extra" Class licenses, one for phone and one for CW? The present holders of Extra Class licenses would then hold both Phone and CW extras. Present or past holders of First Class Commercial CW licenses plus a General or Conditional license would be eligible for a CW Extra. The exam for the CW Extra would be as strict as the Commercial First Telegraph. The Phone Extra would be available to holders or past holders of First Phone licenses plus a General or Conditional amateur license. The exam for the Phone Extra license would be comparable to the First Phone exam, which, in case you don't know it, is a toughie.

The establishment of Extra Class segments in our bands would provide considerable incentive toward achieving these goals. For instance, the CW Extra could be allocated a twenty kilocycle segment at the bottom end of twenty and forty meters. This would not seriously inconvenience the present users of these CW bands as there would still be adequate frequencies for them. No one would be put off the air. Since these frequencies are important for working DX and contests our future lists of contest winners and Honor Rollers would be largely made up of Extra Class licensees, thereby adding even more stature to the achievement. The phone Extra segments could be from 3750-3800 and 14,150-14,200 kc, limited to sideband only. I realize that this will raise problems with Canadian amateurs, but perhaps at this time they can join us on an equal footing. Thus no one, again, would be forced off the air, allowing us to have our cake and eat it too, if I may coin a phrase.

This would put far less of a burden on the FCC for it would not bring on anywhere near the mass of examinations that would be called for if all General and Conditional licensees had to take a new exam in order to stay on the air on phone.

As I say, many other ideas have been suggested. I mention this one because it seems to have the most to offer and the least possibility of danger. This could bring about increased occupation of our bands instead of possibly cutting down on our occupancy at this critical point in time. It would also reverse the present depression which is starting to hit our manufacturers and distributors.

I still believe that a better solution is to encourage fellows to improve themselves and correct any difficiencies that we agree should be corrected. It seems to me that we should be able to bring enough pressure to bear to improve the poor operators through articles and editorials in our ham magazines. If we want to present a better image we can do it simply by merely asking everyone to make it his business to correct inconsiderate amateurs instead of just hearing them and grumbling about it privately. If we want fellows to be better qualified technically we can manage this by publishing articles aimed at helping them.

The attitude of trying to get the government or police to force people to do things that they could be induced to do voluntarily does not appeal to me. You must admit that there has been no attempt to correct any of our problems on a voluntary basis.

Just Like Congress

ARRL members who write in to headquarters complaining that RM-499 does not represent their views have been getting letters back pointing out that Congressmen do not go ask their constituents before they vote for a particular piece of legislation, they just vote as they think best. They then go on to say that this is what the ARRL Directors did.

Sure, this is true of the normal work-a-day legislation that Congressmen have to handle. But when something of universal and vital interest comes up you can bet that there will be a referendum. Do you think for one minute that Congress would put through a law taking away all drivers licenses over a three year period unless the holders passed a new and more difficult test, one which included questions on engine theory? The people would rise up in a storm as the amateurs are now rising up.

The ARRL is implying that their RM-499 is merely routine. This is deceitful.

Opposing RM-499

Never before has amateur radio been so split as it is today over ARRL's petition RM-499. Since it is extremely unlikely that amateurs will find much printed in QST in opposition to their petition, it sort of falls on 73 to give the fellows who are in opposition a place to put across their views.

It is expected that the deadline for sending in comments on RM-499 will be extended to January 11th. I hope that you will read the information herein as well as that presented by QST, plus the Bill Orr article in our November 73, and let the FCC know how you feel about the situation. Don't forget the original and 14 copies.

One of the best petitions to the FCC that has come to my attention was the one sent in by Dana Griffin W2AOE. Dana has taken an active interest in the situation and has not only taken the ARRL to task for their petition, but has many interesting ideas to offer as to methods to accomplish the ends that the ARRL claimed to be shooting for. We'll be hearing more from Dana in future issues.

Perhaps I am wrong, but I don't believe that anyone can read the facts of the case against RM-499 and still seriously support it.

PETITION TO DENY REQUESTS FOR RULE AMENDMENTS AND RULE MAKING

This petition is being presented to the Federal Communications Commission by Dana Adams Griffin residing at 139 Beekman Road, City of Summit, Union County, State of New Jersey. Said petitioner holds an Advance Class amateur operator's license and operates his own amateur radio station using the assigned call letters W2AOE.

Your petitioner has held an amateur license since 1920 and has been employed in the electronic's industry in a variety of engineering and management positions since 1922. He testified professionally at the FCC hearings on television allocations in 1950, at the time being a member of the NTSC allocations committee.

He has been a member of the American Radio Relay League for nearly forty years and has been a frequent contributor of articles of a technical nature to the League's publication QST from the early 1930's up to and including this year, as well as in numerous other technical journals since the mid 1920's.

In the matter of so called incentive licensing, the subject under consideration by the Commission in this proceeding, your petitioner is opposed to the adoption of any and all of the so called incentive licensing schemes which have been presented to the Commission for its consideration.

Particular attention is called to the petition filed by the American Radio Relay League of Newington, Connecticut.

It has been the custom for some time for the ARRL to claim it represents more than 80,000 licensed radio

amateurs.

Under ordinary circumstances, there would be no reason to question this statement. However, since the editorial in the February 1963 issue of QST by John Huntoon, General Manager of the ARRL and Editor of the magazine on the subject of so called incentive licensing there has been a continuous uproar of dissent and assent with respect to the imposition of some form of so called incentive licensing. As late as the September 1963 issue of QST, Editor Huntoon admitted the count was still running 50% for and 50% against so called incentive licensing. It is quite obvious that the ARRL does not represent 80,000 odd amateurs in this matter, since half of its members or QST readers are opposed to the scheme.

In order to get at the facts in this matter, it is necessary to examine the first QST editorial on the subject, which appeared in the February 1963 issue of QST.

Editor Huntoon reviewed the history of incentive licensing and noted its demise in 1952 when major changes in Part 12 of Commission's rules were made.

He then stated flatly and without reservation that the "majority of amateurs favor the principle of incentive licensing." He also stated—"there is no longer a target beyond the standard amateur license *(at least none with practical incentives).*—" This petitioner has added underlining to the above quotation for purposes of emphasis.

It is most important to ***note that none of the reasons for the imposition of incentive licensing now put forth by ARRL were even mentioned in this controversial editorial.***

It took many months and many requests for clarification of the ARRL position by this petitioner and others before the ARRL finally put forth a clear cut statement on the ARRL's reasons behind its intention to propose modification of Part 12 of the Commission's rules to include some form of so called incentive licensing. This appeared in the form of an editorial in the September 1963 issue of QST.

Two reasons were given to support the introduction of the ARRL's so called incentive licensing program. That the American amateur must improve his image at home and abroad by drastically reducing technical malpractices of all sorts and conducting his operations in a much higher class manner than he is doing at present.

The net result of these improvements is alleged to be a principal factor in enabling radio amateurs to retain their high frequency bands in the face of determined efforts in the making by some of the other radio services to take them away at the next ITU conference on high frequency allocation. It is interesting to note that no enhancement of the image of c.w. men is contemplated. From an ARRL point of view one would think that no one outside the United States could read the Morse code or analyze a poor telegraph signal. Evidently only fone men indulge in malpractices and bad manners. Therefore, they are the only ones who must be "worked over" into better individuals.

This belated reasoning is open to serious question in the light of A. Prose Walker's article in the October 1963 issue of QST. In this article Mr. Walker, former member of the Commission's staff, explains in great detail the complex requirements for an adequate defense of amateur service HF band assignments at the next ITU HF allocations conference. While an improvement in our domestic methods and manners on both fone and c.w. will be helpful, such improvements are relatively minor factors in the overall requirements to defend the retention of high frequency band assignments now available to the amateur radio service.

Let us turn to the ARRL's so called incentive licensing proposal in the light of its own statements as to the necessity for the changes it proposes.

Throughout this petition, the term "so called incentive licensing" has been used. We contend the ARRL proposal is being presented under false colors. It is actually a "no incentive" re-examination program for fone men who want to operate on the 15, 20, 40 and 75 meter fone bands in the future.

By passing a new examination, fone men will be permitted to operate on the 15, 20, 40 and 75 meter phone bands ***with no added privileges or improved operating conditions.*** Passing the new examination will permit them to operate just as they are doing at the present time without a single change. Where is the "practical incentive" set forth by Editor Huntoon in February as a reward or incentive?

The answer is obvious and this petition's definition of the ARRL's program is correct. It is a no-incentive program.

From a technical point of view, failure to recommend the elimination of all forms of fone transmission except suppressed carrier single sideband transmission as Australia has already done with its tiny amateur population of less than 5000, provides a clear indication that the ARRL leaders either do not care about or do not recognize the fact that intense QRM (interference) in itself is a major generator of bad practices. QRM caused by excessive population will not go away like a nightmare. Drastic steps are required to alleviate it, the ARRL's "no incentive" re-examination proposal for fone men only cannot conceivably accomplish it.

The effects of overcrowding on human behaviour are easily demonstrated. On the 14th Street bridge in Washington, or the IRT subway in New York, manners are exemplary at 5:00 A.M. and people are quite serene. The situation changes drastically at 5:00 P.M. when overcrowding jams the traffic facilities. The same situation applies on the amateur bands. All is calm at 5:00 A.M., but try your luck on weekends or during the evenings on other days when QRM reaches peak levels. During DX contest periods, the mental state known among hunters as "buck fever" affects the manners of thousands of amateurs adversely.

The imposition of the proposed examination might temporarily reduce the amateur population using fone on these bands. If the examination is stiff enough, thousands of amateurs may fail to qualify, particularly those in the senior citizen class. They will then be deprived of the right to use millions of dollars worth of equipment, except on 10 meters.

Even so, any reduction in actual numbers is highly questionable. The amateur population will rise in 3 years from 270,000 to approximately 350,000 as pointed out in this petitioner's paper "A Survey of Communication Practice on our High Frequency Bands" which appeared in the February and March 1963 issues of QST.

If the novice and general license requirements are made considerably stiffer, we can expect the growth rate to slow down and possibly a better prepared group of novice and general licensees will result. In this respect, this petitioner agrees with ARRL policy in calling for stiffer novice and general license requirements.

This petitioner believes he is on firm ground in stating that no examination conceived by man can prevent technical malpractices of either an accidental or a deliberate nature, or that passing any examination can cause an improvement in personal manners particularly under conditions of stress. If this were possible, we could have all of our citizenry take appropriate tests and then proceed to dismantle our police forces and houses of detention.

What is really needed in our American amateur radio service is a major self-policing effort on the part of a substantial portion of the amateur population. Such a group must help the unwary to stay within bounds and attempt to keep the selfish extroverts in line as well. This suggestion was made to a number of ARRL leaders last March at a special meeting in New York. While received with some initial enthusiasm, it apparently has been dropped.

The ARRL claims the amateur body is self policing. A most casual examination of its numerically insufficient "Official Observer" group, with its postcard reports of violations long after the fact, quickly shows this claim to be false. Better yet, the continually increasing amount of malpractice on the air demonstrates very quickly that the term "self policing" amongst amateurs is a hollow joke. This situation can be corrected without amending the Part 12 rules. A major continuing educational campaign is required.

Now let us turn to the timing schedule proposed by the ARRL. On the one hand, the ARRL leadership frantically calls for immediate improvement of our image at home and abroad. Under their program, they propose to improve it starting in 1965 on the twenty meter band, in 1966 on the 15 and 40 meter bands and in 1967 on the 75 meter band.

Why domestic and foreign impressions of the American amateur are more important on 20 meters in 1965 than

those received on 15, 40 or 75 meters during 1965 is a real mystery to this petitioner. Do our own government officials as well as those overseas have frequency conscious time clocks in their minds which prevent them from hearing nasty things on 15, 40 or 75 meters in 1965? Actually ionospheric propagation being what it is these days, good reception can be obtained on all four bands both here and abroad.

It should be quite clear at this point that the ARRL is proposing a "no incentive" re-examination program for fone men only which will cost the FCC and thousands of individual amateurs hundreds of thousands of dollars to undertake.

The program will go into effect so slowly that even if *any sort of technical examination* could reduce accidental or intentional malpractices, horrible examples of said malpractices will be available for all the world to hear until 1967 on the 75 meter band.

It becomes quite apparent that even if the ARRL program could conceivably work, its timing is far too slow to provide an improved image of the American amateur at home or abroad.

Intensive preparations for the next major ITU conference on HF allocations will start long before 1967 in every country in the world and most impressions of the American amateur will be formed long before that time. In fact, a good many rather permanent impressions undoubtedly already exist both at home and abroad.

The lack of thought, bona fide incentives, provisions for technical advancements in operating practices, improvements in telegraph operations as well as fone operations, and a major self policing effort, all of which are missing in the ARRL proposal, may raise a rhetorical question in the minds of the Commission as to how the ARRL proposal ever was developed and presented to the Commission for serious consideration.

We believe the answer lies in the area of the basic structure of the ARRL and its traditional, outmoded policies in areas involving engineering considerations. Quite properly no one can serve as an officer or member of the Board of Directors of the ARRL who is engaged in the radio business. This is a wise provision to protect the amateur radio service from destruction from within.

What is most unwise is the ARRL's failure since its inception (particularly in the post World War II period) to even hire competent professional help in the complex areas of allocations, frequency utilization long range planning, etc.

Its Board of Directors or its Executive Committee comprised of competent men in many walks of life (except radio communications) prepares its own technically involved plans on a more or less emotional basis with some assistance from its QST publications staff who are also emotionally involved from many standpoints.

It is quite apparent to many thoughtful amateurs experienced in business management, that if you pay for advice prepared by experts in a technical field, any Board of Directors is then in a position to act wisely on a basis of fact, not wishful thinking.

The rejection by the Commission of the subject ARRL proposal and others now before it may have a salutary effect on the future management policies of the ARRL, insofar as its dealings with the Commission are concerned.

The Commission may see future ARRL proposals that include bona fide improvements in the modus operandi of the amateur radio service, which undoubtedly would be most welcome. They have been conspicuous by their absence for many years.

SUMMARY

1. It is the contention of this petitioner that the ARRL proposal and other proposals for various forms of so called incentive licensing, now under consideration by the Commission are misguided efforts to legislate technical competence and/or better manners into the amateur radio service which are doomed to failure.

2. Bona fide self policing of the amateur bands by thousands of qualified amateurs will provide the desired results very rapidly and will not require any change in Part 12 of the Commission's rules.

3. The ARRL request for a special examination for fone men only if implemented, will cost the Commission and thousands of amateurs a great deal of money and will not improve the situation in any manner.

4. The proposed timing of the ARRL program is too late to achieve the desired result, an improved image of the amateur radio services by outsiders listening in on the amateur bands, prior to preparations for the next ITU conference.

5. Lastly the ARRL position is not representative of a majority of amateur opinion in this matter. Indeed, if equal opportunity to present this petition or similar petitions opposing so called incentive licensing to the amateur body had been available, support of the ARRL position would undoubtedly diminish very drastically well below the claimed support at 50% of the amateur population.

For the reasons and facts presented herewith, this petitioner prays that the Federal Communications Commission will deny any and all proposals for incentive licensing under consideration in this proceeding.

They cannot provide the improvement of the image of the American amateur radio service which they purportedly will accomplish. Therefore, they cannot enhance the public interest, convenience or necessity.

Respectfully submitted,
Dana A. Griffin
Petitioner
October 21, 1963

OPPOSITION TO PETITION FOR RULE AMENDMENTS AND RULE MAKING

Preliminary Statement

This Memorandum ***in opposition*** to the Petition for Rule Amendments and Rule Making of the American Radio Relay League Inc. dated October 3, 1963 (the "League") is being submitted by Harry Balterman, the holder of General Class Amateur Radio License K2BMD (the "Opponent"). In the points to follow, Opponent will demonstrate:

1. The League's proposal is a unilateral, autocratic proposition conceived and proposed in bad faith.
2. The League's proposal will destroy the entire concept of amateur radio.
3. The proposed rule violates Section 9(b) of the Administrative Procedure Act.
4. The proposal of the League will foist upon the taxpayers of the United States the unnecessary and intolerable burden of the costs of re-examination, administration and monitoring.
5. The proposed rule would deprive amateur radio operators of property without due process of law.
6. If incentive licensing is deemed desirable, the Commission should reject the League's proposals and set aside portions of frequencies presently limited to A-1 operation.

POINT I

THE LEAGUE'S PROPOSAL IS A UNILATERAL, AUTOCRATIC PROPOSITION CONCEIVED AND PROPOSED IN BAD FAITH.

The nuclear explosion of "incentive licensing" (which in actuality is an involuntary "restrictive licensing") was triggered by the League in the February, 1963, issue of QST. Upon turning to Page 9 of that issue, Opponent, who has been a licensed radio amateur operator, and a member of the League, since 1952, read that the 1932 regulations requiring a special class of license as a prerequisite to operation on the then newly-established voice bands at 75 and 20 meters originated with the League at the request of ***serious phone men who were distressed at the low standards and poor techniques too often employed by some operators at the time.***

He also read that:

"Most amateurs want a return to the incentive system of licensing. They feel that the 1952 action (of abolition of Class A, B and C licenses) was a step backwards. They argue that because there is no longer a target beyond the standard amateur license (at least none with practical incentives), the U. S. licensing system has bred mediocrity and resulted in deterioration of the general level of our technical knowledge. They say too many of today's amateurs are 'plug-in-appliance' operators. They want a return to the principal of special privileges after proof of special ability, a reinstatement of some form of the earlier system—perhaps a modern version of the old Class A examination, bringing it in line with current requirements and techniques."

The following thoughts immediately come to Opponent's mind: Is it not strange that the "*serious* phone men" who were distressed at the alleged low standards and poor techniques employed by operators in 1932—over thirty years ago—are still distressed today! What makes one into a "*serious* phone man"? And what is a "*not serious* phone man"? Who is the arbiter? And who is the teacher! The old timer? The new operator? The 25 year man? The 10 year man? WHO??

It became immediately obvious to Opponent that the League was not really proposing *incentive* licensing but was in reality seeking *special privileges.* Equally obvious was the fact that a red herring and straw man technique of argumentation would be employed. A technique that would have to develop for itself as time went on and according to the exigencies of the opposition.

Continuing to read, your Opponent was startled to read the following statement of the League:

"We feel we can safely affirm that a majority of amateurs favors the principle of incentive licensing."

Further along in the article, Opponent read the following:

"Would a return to restricted phone bands act as a suitable incentive for amateurs to advance technical proficiency? Would it improve the quality of our signals and thus conditions in our bands? Would this upgrading of amateur standards outweigh the inconvenience to Conditional and General licensees who would temporarily be limited to lesser privileges while they study for the additional test? Would the incentive system operate in the best overall interests of amateur radio, transcending the initial injustices it would certainly work upon some of us?"

Having asked these four questions, the League, of course, answered them immediately and said: "We feel the answer in all cases is a definite yes."

The Commission will note that at this point of time, the League was concerned with the following major factors:

1. Technical proficiency
2. Quality of signals
3. Conditions in the bands
4. Special privileges

On February 4, 1963, Opponent wrote to the League and challenged the truth of the statements contained in its article. He charged then, as now, bad faith. He charged then, as now, use of the technique of "the big lie." He demanded to know who polled the amateurs and when. Opponent advised the League that in his opinion the League had no right either morally, ethically or legally to proceed with a proposal to the Federal Communications Commission to institute special privilege licenses unless it took a poll of all of its members and was authorized to file such proposal by a majority vote of the membership. Other amateurs demanded the same thing for they felt that every one had a right to be heard.

The League deliberately, contumaciously and contemptuously failed and refused to conduct a poll of its membership. The determination to petition for a special privilege class of license was made unilaterally by sixteen members of the Board of Directors of the League—and not by the membership!

Opponent complained to the League in February, and complains now, that the League is dominated by, and caters to, a select minority group of old-guard diehards who feel that the airwaves are their exclusive property. Opponent complained then, and complains now, that one of the major objectives of the League's proposal is to eliminate the large group of young people who are on the air today. Opponent is forty-four years of age and received his license when he was thirty-three. He was one of the first of the K calls. At that time, it was his experience that the K calls were shunned by the W calls. It is Opponent's firm belief, and this can be proven, by monitoring the airwaves, that the WA calls and the WB calls of today are met with the same distaste by the "old-timers" as the K calls in 1952 and 1953. Of course the voice bands are crowded. Of course there are plenty of young folks on the air today including *very* young folks. But they have the same American right to be on those airwaves as the 55 or 65 year old man who sits at his super-kilowatt rig and cries and moans and spits about the "good old days." *Opponent is very proud of the amateur license which he holds.* He also believes that he has served the cause of amateur radio well. When the MARS program was active, Opponent, who holds the call AAF2-BMD, was one of the few individuals in the Long Island —New York area authorized by the Pentagon to operate on 14,405 kc in the international MARS net. Hundreds of phone calls were made through the medium of AAF2BMD to all parts of the United States from North Africa, France and the northern-most regions of this hemisphere. Opponent received commendation from the Chief of MARS and other high-ranking officials at the Pentagon for his services as well as countless bits of thanks and appreciation from overseas military personnel and their families at home. These services were rendered willingly, happily and efficiently, despite the fact that Opponent had a K call and despite the fact that Opponent was not a professional electronics engineer.

The League has consistently ignored the demands of membership that a poll be taken. There are approximately 250,000 licensed amateurs in the United States. The League claims membership of approximately 80,000. These 80,000 members have been deliberately and wilfully ignored by the League. Nevertheless the League purports to act as the representative of not only the 80,000 but of all 250,000. This is the epitome of autocracy.

In the March, 1963 issue of QST, the League acknowledged that it had "stirred up quite a lively discussion." Nevertheless, it clearly and unequivocally stated that the decision as to whether or not a proposal to change the licensing system should be presented to the FCC will be made only by the Board of Directors of the League. The League thus admittedly becomes the VOICE OF AUTOCRACY and the "General Motors" of the amateur society—deciding that what is good for it is good for all amateurs!

The League, however, in March, already realized that in order to put across its proposal, it would have to embark upon a course of conduct that would embrace confusion as its password for it is far easier to confound confusion than to convince by clear and understandable logic. Apparently, the writer for the League must have read Mark Twain where it was said: "The more you explain it, the more I don't understand it." (See also *SEC* v. *Chenery Corp.*, 332 U. S. 194, 214.)

Thus, let us see what the League began to do:

In February, it spoke of advancing technical proficiency; improving the quality of signals; improving conditions in our bands; and special privileges. In March, it states that it is a misconception to believe that a principal objective is to reduce the number of amateurs using certain voice bands and thus the QRM. It states further that neither is the proposal proposed exclusively as a remedy for poor signals and bad manners on the air. It admits that a higher grade of license will not automatically make a gentleman of a licensee. It does not, of course, admit that the same degree of technical proficiency should be required for a c.w. operator as a phone operator. It focuses its attention upon voice operation and not code operation.

Is it not peculiar? Is it not amazing? The League never discusses the c.w. operator. Voice operation is treated as a privilege and c.w. operation apparently is relegated to the haven of mediocrity (to use the League's own words). Technical proficiency, quality of signals, conditions in the bands and special privileges can be

safely ignored in the c.w. portions of the spectrum. Why? How come? Does the c.w. operator wield a mace?

In the same issue of QST (March, 1963), the League clearly and unequivocally states that amateur radio is a HOBBY. Thus, it states in the 10th paragraph of its editorial on Page 10 as follows:

> "It is the duty of the League to push for improvement in all the various phases and interests of amateur radio—public-service potential, operating ability, courtesy, technical proficiency and just plain enjoyment of ***our hobby,*** to name a few. The restricted voice band proposal is primarily aimed at just one of those —technical proficiency. Its purpose is to spur the amateur body with a challenge to improve personal ability in the technical radio field, which is certainly in the national interest, and to do so by providing an incentive, which does not now exist, in the form of ***special privileges.***" (emphasis added)

Note please the use of the word HOBBY. It is the next to the last time that the League will admit that amateur radio can be deemed a hobby. Also please note the "special privileges" concept.

The March issue of QST determines that it will endeavor to camouflage the "special privilege" approach by embarking upon an educational program with respect to effective spectrum use. Opponent is in full accord with the recommendations and objectives of the League insofar as effective spectrum use is concerned. Opponent is certain that all amateurs are in accord with the recommendations as set forth at Page 65 of the March issue of QST. But that is not the issue now before the Commission. Opponent resents, decries and protests this deliberate attempt to confuse which is also present in the very petition for rule making that has been presented to the Commission. Thus, the Commission itself is being presented with the same article, in substance, as appeared in the March, 1963 issue of QST. Opponent refers to the initial material under the heading "The Proposed Solution" contained in the League's petition. Opponent states that the League's objective of efficient spectrum use is in fact the solution to the complained of problem. Restrictive or Special Privilege licensing is not the solution.

In June, 1963, QST announced to the amateur fraternity that posterity will record the 1963 meeting of the Board of Directors of the League as one of the most significant in the history of the League. That is a bit pompous, it is not?

Opponent earnestly requests the Commission to ask the League for copies of the June, 1963 QST so that it can read the remarkable dissertation upon the League's virtues and achievements written by the League itself.

The League has now become the protector of the public interest, convenience and necessity; it has assumed for itself the task of proving to the world that there is justification of continued retention of amateur frequencies; it has become the interpreter of the rules of the Commission; it has become the voice of persons "highly placed in the communications regulatory field"; it pontificates that operating pleasure alone is no justification for the continuance of amateur radio; it transforms amateur radio from a hobby into a profession; it becomes the seer and portender of doom and advises that if amateur radio continues as a hobby, it will soon disappear; it assumes the task of Government; and it announces that it will make amateurs absolutely "superb." ***Sic transit gloria mundi!***

The League, in the same article, warns that its Board of Directors has faced a real challenge at its 1963 meeting; pridefully advises that the course of future events has now been charted; states that we should be proud of them; and commends the Board members to posterity!

The announced goals of the League now become (in March):

1. Increased amateur technical proficiency
2. More efficient use of amateur frequencies
3. More effective performance in the public interest, convenience and necessity

Having been subjected to devastating attack by its membership, the League, in its July issue of QST, states that its position "was adopted by the Board of Directors, a group of sixteen mature and capable amateurs elected by the membership to formulate ARRL policy." 16 people! 16 mature and capable people! These 16 have presumed to legislate for 250,000! The League states that "the Board's action, knowing beforehand of the furor it would create, took considerable courage." Opponent states that it took considerable gall!

By September of 1963, the League was visited with the light of genius. The "Society of Sixteen" now issues its holy writ that the trouble with amateurs is that they assume that the FCC has exclusive jurisdiction over frequency usage in the United States whereas the fact is that frequencies are allocated at international radio conferences and the FCC can make domestic assignments only within the basic pattern of international agreements.

We now witness the circle going full round. The League now states that its objective "simply stated is a program to preserve amateur frequency bands" (Page 9, September QST).

A contemporary author has written:

> Christopher Robin goes
> Hoppity, hoppity
> Hoppity, hoppity, hop.
> Whenever I tell him
> Politely to stop it, he
> Says he can't possibly stop.

This is the League! This is the "Society of Sixteen." They just cannot stop! They are on an electronic merry-go-round and will not get off! For months, reason after reason after reason has been advanced for their actions and now, in September, 1963, they state that they only want to preserve amateur frequency bands. Opponent commends the editorial at Page 9 of September QST to the Commission. All amateurs want to preserve our amateur frequency bands. All amateurs desire to join together in a common effort to preserve and improve radio. But the League is wrong. There is not only one answer—their answer. That is Khrushchev speaking. In the United States, we believe in democracy. In the United States, we acknowledge that there can be more than one side to an issue. We do not state: "Do it my way or else do not do it!"

Apropos of this subject, Opponent desires to bring the attention of the Commission to an amusing incident which occurred on the air only recently. In discussing the subject matter of the League's proposal with an "old timer"—a two-letter call man in Florida—Opponent was told that if he did not like the League's proposal, he should surrender his ticket and get off the air. This is typical of the League's old-guard. "If you don't agree with us—get off the air." Opponent has no intention of getting off the air. Opponent is an attorney-at-law and has been since 1947. He is fully capable of passing any radio theory examination that may be put before him. However, he wishes to point out that when there are changes in medicine, doctors are not required to take new examinations and when there are changes in law, lawyers are not required to take new bar examinations.

In October, the League, without the authorization of its membership, presented the subject petition. The petition is, like all of Gaul, divided into three parts:

1. The alleged raison d'etre of amateurs.
2. The alleged problem.
3. The alleged solution.

The petition will be carefully analyzed in the succeeding point. Suffice it to say at this time, however, that in the November, 1963 issue of QST, the League is still trying to think of why it filed the petition. Thus, in the first paragraph of its editorial on Page 9 of that issue, the League states that in accordance with instructions of its Board of Directors (the "Society of Sixteen"), the petition has been filed and:

> "The purpose is to provide additional self-training goals, and thus to strengthen the position of the amateur radio service in both domestic and international affairs."

The League, however, does not appear to be quite convinced as to why the petition has been filed (and to this day, your Opponent does not know why either) for only two short paragraphs away, the League finds it necessary to again state the purpose and sets forth:

> "Its purpose is to attain a substantially higher average technical level and thus improve the stature of the amateur service."

Upon examination of all of the material published in

QST upon the subject, it seems apparent to Opponent that each of the "sixteen mature and capable amateurs" who have determined to chart the course of 250,000 other amateurs have each had an opportunity to write their own editorial because none of the editorials ever say the same thing!

The League, in its new-found role of prosecutor, defender, judge and jury, demonstrates in this self-same November, 1963 issue of QST that, in its opinion, it is already a foregone conclusion that the proposal will be adopted in substance by this Commission. Thus at Page 10 of the November QST, the League states as follows:

> "The next move is up to FCC. The Commission might issue a notice of proposed rule making embodying the suggested changes, or it might modify them as its judgement dictates. Before any substantative changes are made final, of course, administrative procedure requires that all interested parties be given an opportunity to express their views."

The Commission will note that not for a moment does the League consider the possibility that the Commission may *not* issue a notice of proposed rule making. It takes it for granted that the Commission will, in fact, issue a notice of proposed rule making although it does acknowledge that the League's proposals might be modified. One might think this attitude incredible were it not for the incredible fact that the League is presenting a proposal affecting its entire membership without polling its membership and without authority.

Will this Commission allow itself to be dictated to by the autocratic fiat of the "Society of Sixteen"? Or will this Commission recognize the League's ill-founded, ill-conceived proposal for what it really is?

POINT II

THE LEAGUE'S PROPOSAL WILL DESTROY THE ENTIRE CONCEPT OP AMATEUR RADIO.

The term "amateur" is defined by most dictionaries as meaning the cultivation of a particular pursuit, study or science, from taste, without pursuing it professionally.

The League's proposal admittedly is pointed toward making the amateur radio operator into an "electronics expert." (See Page 9 of June, 1963 QST.)

Let us now examine the petition itself. The petition is divided into three categories:

Topic A: The alleged reasons for being of the amateur radio service.

Topic B: The alleged immediate problem.

Topic C: The alleged solution.

Topic A

The material set forth by the League under Topic A is nothing more than a bout with semantics. The semantologists in the League's "Society of Sixteen" have conducted a contest amongst themselves and the winner that has emerged is the proponent of the doctrine of "Service." It is now determined to varnish deception by means of disingenuous emphasis on the word "service." This quixotic tilting with windmills takes place so as to destroy any concept of amateur radio as a "hobby." The propostion is advanced that if amateur radio were to be deemed a hobby, it could not justify its existence. This fallacious and specious argument is a straw man and a red herring. It is a sham resort to a "fear" type of argument that distorts reality and substitutes in its stead pontification—nothing more than a form of catharsis.

The reason why amateur radio as well as other divisions or departments or arms of radio frequency communications is termed a "service" is best known to the Commission. While Opponent is the proud possessor of an amateur radio license and treats amateur radio with the highest regard, Opponent submits that amateur radio stands on its own feet and does not have to be justified by calling it a "form of service, both to the public and to the nation." The fear technique employed by the League in its Topic A is the culmination of the League's tortuous striving to find a justification for its proposal. Opponent's POINT I has demonstrated that the League has hopped from foot to foot in trying to justify the submission of its proposal. The straw man and red herring of "service" should be recognized for what it is and should need no further comment.

Topic B

The material that is set forth by the League under its Topic B is a classic classroom example of spurious conjecture. A hypothetical question that assumes a state of facts not shown by the evidence to exist. Thus, the League artificially *creates* two problems that have no foundation in fact.

Problem No. 1

Once an amateur has obtained his General or Conditional Class license, he no longer has any practical or meaningful incentive to increase his technical knowledge and proficiency and earn a higher grade of license.

This is purely *post hoc ergo propter hoc* reasoning—an utterly illogical form of reasoning! It is sheer drivel! It is sheer nonsense! It is the same as saying that a lawyer stops reading law journals and law books once he becomes a lawyer and a doctor stops reading medical journals and medical reports once he becomes a doctor. A lawyer cannot earn a higher grade of license. A doctor cannot earn a higher grade of license (specialization is not a state granted license). An engineer, once he becomes an engineer, cannot earn a higher grade of license. A certified public accountant once he becomes a CPA cannot earn a higher grade of certification. But law, medicine, engineering and accountancy do not come to an end because there is no incentive of higher grades of licenses! But sixteen membrs of an autocratic socity have determined for themselves that no amateur radio operator will study or have any concern with radio once he gets his General Class license because he has no incentive of a higher grade of license.

The answer to the League's supposititious Problem No. 1 is simply—POPPYCOCK!

Problem No. 2

The League is greatly concerned because the design and construction of manufactured equipment is excellent and the operation thereof is simple. Ergo, says the League, it no longer is necessary for an amateur using such equipment to have practical knowledge sufficient to construct his own equipment or to even fully understand the circuitry and theory of operation of the manufactured equipment.

It is now, says the League, open season on manufactured equipment. Back to the days of Guglielmo Marconi! Damn the transistor! Full speed back to the spark gap!

There can be only one answer to this bit of nonsensicality—this burlesque of truth. One word: *HUMBUG!*

Topic C

Opponent does not have any dispute with the first five full paragraphs appearing in the petition under the topic "The Proposed Solution." Opponent does, however, violently dispute all of the material contained in the sixth and following paragraphs under this topic commencing with the words "After extensive study, etc." Opponent states that in his opinion the answer of the League is not the answer. He states unequivocally that it has not been demonstrated that the public interest, convenience and necessity will best be served by the adoption of the League's proposal!

Opponent submits that the League's proposal is, in effect, punishment where no crime or offense has been committed. Sixteen people have indicted and convicted 250,000. High crimes and treason (indolence and ineptitude) are charged. High crimes and treason are proven. But the defendant is neither identified nor in the dock. The League indicts; the League prosecutes; the League defends; the League judges; the League convicts. Heresy has been pursued by the Society of Sixteen—tried—convicted! Off the air is the verdict of the Inquisition.

Let us examine what would happen if the League's proposal were to be adopted. Only a limited number of possibilities necessarily exist:

1. Most amateurs will take the examination.*
2. Few amateurs will take the examination.*
3. Most of the amateurs who take the examination will pass.
4. Few of the amateurs who take the examination will pass.

If eventualities 1 and 3 come to pass, amateur radio will be exactly the same as it is today and nothing will have been accomplished. We will all be back to the exact same point of starting. The self-same cry will then be raised. No incentive because we have all passed. We

* It is reasonable to eliminate the category of *all* amateurs and of *none*

have nothing to look forward to because we have all passed. What then? A new rule making procedure? A new punishment? Ad infinitum!

If eventualities 1 and 4, or 2 and 3, or 2 and 4 come to pass, the high frequency bands will be practically deserted and amateur radio will, in effect, have received a setback from which it will not easily recover. Why? Because then it will be claimed that amateur radio does not need the frequencies assigned to it because they are not in use. Imagine then the weeping, wailing and gnashing of teeth at the international conferences when the member countries contend that the United States does not need any reservation of high frequencies for amateurs since they are not in use. What then will it avail us to claim that the reason why they are not in use is because we require our amateurs to be electronics experts before they can use those frequencies. The 15, 20, 40 and 75 meter bands are precious privileges. We can only keep them through utilization. We will lose them through non-utilization. We will lose them if an amateur has to be a professional before he can operate on those bands. We agree with the League that retention of frequencies is of inestimable value. We do not, however, want to risk the loss of our frequencies—as does the Society of Sixteen. We desire that all amateurs who hold the General Class license be permitted to continue to use those privileges which have been granted to them by the United States Government. We desire that the goodwill that is presently being spread throughout the world by the U. S. radio amateur be permitted to continue. We desire that the amateur "voice of America" continue to be heard. The favorable image of the American "ham" (if you please) should be allowed to continue to penetrate the world—on phone—as well as on c.w. We do not hold to the proposed deprivation of the privileges to really *serve* the public interest—to really *serve* our country. We do not hold to a suppression of Americanism. Our record is clear and convincing. The light of true American democracy has been spread by amateur radio. It should not be circumscribed. It should not be extinguished.

POINT III
THE PROPOSED RULE VIOLATES SECTION 9(b) OF THE ADMINISTRATIVE PROCEDURE ACT.

If the petition of the League is approved by the Commission and a new rule adopted by the Commission taking away radio-telephone privileges of the General Class license in the 15, 20, 40 and 75 meter bands, such rule will be, in effect, a withdrawal or a partial suspension, revocation or annulment of a license already granted. Section 9(b) of the Administrative Procedure Act provides that except in cases of willfullness or those in which public health, interest or safety requires otherwise, no withdrawal, suspension, revocation or annulment of any license shall be lawful unless, prior to the institution of agency proceedings therefor, facts or conditions which may warrant such action shall have been called to the attention of the licensee by the agency in writing and the licensee shall have been granted the opportunity to demonstrate or achieve compliance with all lawful requirements.

The Senate Committee report on the Administrative Procedure Act clearly indicates that the standard of *public interest* referred to means a situation requiring immediate action. Obviously no such public interest as would meet the required test has been shown here to exist.

It is submitted that the proposal of the League, if adopted as a rule, would amount to a sanction; that no cause for such sanction has been shown to the Commission; that no facts or conduct which may warrant the revocation of voice privileges already granted have been shown to the Commission; and that, accordingly, there is no power in law to take away such privilege.

Furthermore, if authority in law be deemed to exist, then, and in such event, facts or conduct which may warrant the contemplated action by the Commission must be called to the attention of each and every General Class licensee by the Commission and each and every holder of a General Class license must be granted the opportunity to demonstrate or achieve compliance with all lawful requirements.

But no facts or conduct can in actuality be called to the attention of a holder of a General Class license because no fact has occurred, and no conduct has taken place, which could warrant the contemplated action other than the fact that the Commission might have adopted an *ex post facto* rule. The proposed rule, therefore, becomes, *ipso facto,* violative of Section 9(b) of the Administrative Procedure Act.

POINT IV
THE PROPOSAL OF THE LEAGUE WILL FOIST UPON THE TAXPAYERS OF THE UNITED STATES THE UNNECESSARY AND INTOLERABLE BURDEN OF THE COSTS OF RE-EXAMINATION, ADMINISTRATION AND MONITORING.

Since there are approximately 250,000 amateurs, it can be reasonably anticipated that if the proposal were to be adopted as a rule of the Commission, and if the bulk of such amateurs were to take the examination, the costs to the Government would range from $10 to $100 per person.

This cost estimate is based upon man-hours involved in devising the examination; man-hours involved in giving the examination; man-hours involved in marking the examination; man-hours involved in re-examinations of those who fail the first time; man-hours involved in mailing notice of passing and/or failing, as the case may be; man-hours involved in mailing new licenses; innumerable other man-hour items, including general administrative costs and costs of monitoring as well as printing and similar costs.

Opponent firmly believes that the cost to the United States Government of the League's proposal will easily range between $2,500,000 and $25,000,000. An expenditure of this magnitude should be clearly submitted to Congress for approval and should not be undertaken by the Commission at this time.

POINT V
THE PROPOSED RULE WOULD DEPRIVE AMATEUR RADIO OPERATORS OF PROPERTY WITHOUT DUE PROCESS OF LAW.

It is an elementary proposition of law that governmental restriction of use of property must have as its purpose the protection of public health, morals, safety, order or general welfare. Otherwise such restriction is oppressive, destructive and violative of due process of law.

General Class licensees have, in reliance upon the license already granted to them, and in reliance upon the privileges afforded to them by such license, expended considerable sums of money in connection with the acquisition of transmitting and receiving equipment. The investment of many individual amateurs who fall within this category exceeds $1,000. To be summarily and arbitrarily deprived of the use of this equipment by a restriction on the use of their license absent a showing that such restriction is designed to protect the public health, morals, safety, order or general welfare, is oppressive and destructive and, accordingly, a deprivation of property without due process of law.

POINT VI
IF INCENTIVE LICENSING IS DEEMED DESIRABLE, THE COMMISSION SHOULD REJECT THE LEAGUE'S PROPOSALS AND SET ASIDE PORTIONS OF FREQUENCIES PRESENTLY LIMITED TO A-1 OPERATION.

Opponent has heretofore stated that it is quite strange that at no time has the League made any reference to c.w. operation. Opponent will not attempt to endeavor to determine why this is so. Opponent submits, however, that if, in fact, it is deemed desirable to have some form of special privilege license, then the Commission should establish special privilege phone bands other than those phone bands now in existence. The Commission should allocate portions of frequencies that are presently limited to c.w. operation for holders of special class radio telephone licenses. This then would be incentive! This then would not be punishment! This then would provide stimulation for further study if such further study is necessary! This then would compel those amateurs who are not otherwise interested in the make-up of their equipment to see what makes it tick! This then would be fair; not unreasonable; and not oppressive.

POINT VII
CONCLUSION

1. The petition of the League should be denied in each and every respect by reason of the fact that the public interest, convenience and necessity will not be served by the adoption of the proposals contained in such petition.

2. In the event the Commission determines that the concept of incentive licensing should be adopted, then, and in such event, the Commission should not adopt the rules proposed by the League but should adopt rules pro-

viding for a special class of radio telephone license to be issued only after special examination, which special class of license would permit A-3 operation in portions of the 15, 20, 40 and 75 meter bands presently reserved for A-1 operation.

Respectfully submitted,
Harry Balterman
Attorney and Counsellor-at-law

In addition to the many petitions sent in to the FCC there were innumerable letters mailed to the ARRL. The following is typical:

W—2—S—H—Z
3 No. Belmont Circle
Oneonta, New York
November 12, 1963

Board of Directors
American Radio Relay League, Inc.
225 Main St.
Newington 11, Conn.

Gentlemen:

By way of introduction: I am 50 years of age, and have been licensed since 1955. (W8MTZ, KZ5HE, W2SHZ) I am employed as a television repairman by a company of national scope, and was an electronics technician during WW II and the Korean conflict. I have had little formal education in this field.

I am not, by definition, a "balanced amateur," in that my main interest in amateur radio is the contacting of as many different countries as possible with moderate power (one hundred to two hundred watts). I prefer CW to phone, and most of my activity has been via this medium. However, I handled much overseas traffic after WW II, when such traffic seemed to have a real meaning; I have done a modicum of VHF work; I belong to AREC and RACES; I hold a RCC certificate, and adhere to the principles of RCC; I am frequently an officer in the local radio club; until the past year my equipment has been home-made, generally modified from an existing design, to fit my needs, except for a BC 312E which has been the station receiver for seventeen years. (That too has been extensively rebuilt.) In the past year I purchased a compact band-switching transmitter which incorporates DSB and AM as well as CW, and dispensed with the old rig. I passed the Advanced Class License examination when its provisions meant nothing to me, and was an early recipient of the Extra Class Ticket, passing these tests, as Hilary may have said, "because they were there."

So much for myself—who are you? Do you belong to the worthy group described in the following editorial?

Representative Government

> I asked my father once why the Puritans left a perfectly comfortable country to come over to the New World with its savage Indians and hard life. His answer was, "In order that they might be able to worship God according to the dictates of their own conscience—and prevent others from doing the same."
>
> I have thought about that many times in A.R.R.L. affairs. It gets one down to the fundamentals of government. It's a good thing to get down to fundamentals every once in a while. It keeps one from getting off the road and becoming lost.
>
> Our A.R.R.L. government is strictly Representative. Every two years our members in each of our fourteen divisions elect a man to represent them. These fourteen men are the directors of the A.R.R.L. What the majority of them vote to do is what the majority of the country thinks is best, and it is done.
>
> These men select a President, a Vice President, a Secretary, a Treasurer and a Communications Manager. They allow the President to vote to break a tie and they allow the Vice President to vote. All the other officers are hired men and they have no vote. The directors may hire or fire them at will. In other words, the directors, representing the entire country, are the rulers of the A.R.R.L. It is typically American.
>
> The President may howl his head off for something. Unless he can convince a majority of the other fifteen directors that it is best for A.R.R.L. as a whole, he is turned down.
>
> A Director may argue and threaten for something that his Division wants. Unless he can convince a majority of the other fifteen directors that it is best for the A.R.R.L. as a whole, he and his Division get turned down.
>
> In other words, no man nor no local group of men can impose their will upon the whole. Nobody can "prevent others from doing the same."
>
> That's Representative Government. This history of human affairs has shown that it's the kind of government that succeeds.

This editorial appeared in QST for November, 1927. It was written by the founder and, at that time, President of the League, Hiram Percy Maxim, who must be convoluting in his grave like a dervish if any of these suppositions and accusations presently being bandied are true.

What of these accusations? I assume your collective ear has been close enough to the ground to hear of that newsletter which says some mighty un-nice things about you. Sorting out the chaff of that diatribe I concluded that there was enough smoke to indicate some degree of combustion. My first reaction was that there could be no basis of fact behind such statements, and I expected to see a law suit filed in due order. I have watched for two months for some action to be taken.

Gentlement; I don't feel that a situation like this comes in the category of a small dog snapping at the big boy's heels. If there is no reason to doubt the integrity of the Board of Directors, a reassuring statement should be issued, and the veracity of the allegations in the Doyle papers should be firmly disclaimed. If, on the other hand, Mr. Evans is rattling your skeleton, you should let your constituents know what measures you are taking to prevent such a practice from recurring.

The matter of Incentive, or, as some say, Restrictive Licensing seems to have launched a contraversy which overshadows any of the modern day magillas. I did not take part in the Spark vs CW strife, so cannot speak with authority, but I wonder if that schism was more pronounced than that which splits our ranks today.

Personally, as an amateur, it makes little difference to me whether or not Incentive Licensing is brought about. I'll pass the test and operate in the band of my choice. I may have to cross into the ELECTRONIC GHETTO this proposal will create in order to contact some of my friends, but I expect that discomfort to be balanced by the pleasure of operating in bands which have been cleared of all the "undesirables."

You are not, however, pushing this change to produce such results. Do I conform to any of your objectives? As for my technical ability, I am sure it will not be enhanced by association with others of my ilk. As for the great discoveries made by amateurs in the past, they might seem to parallel the great explorations made when man's knowledge of geography was more limited. Our "Electronic Astronauts" are few, and Incentive Licensing will not increase their numbers.

Will Incentive Licensing make me more a gentleman on the air? I think not. Our fathers could not legislate temperance, we can not legislate morality, and you, gentlemen, will not legislate courtesy.

What of the Public Interest? Will membership in AREC/RACES be a prerequisite to the issuance of this license? Will cancellation of privileges follow a failure to make BPL so many times a year? This too cannot be legislated. There will always be a hard core group of hams dedicated to the public interest while the chips are UP, and, as in time of war, there will be a large majority of hams pursuing their hobby, as a reservoir of

untrained personnel who will serve when the public interest demands it.

At times I deplore the dearth of home-built equipment in the shacks I visit. Many hams wouldn't know the type of tube in the final stage of their transmitters, and haven't the slightest idea of the correct method of adjusting a BFO for optimum CW reception. Reading that their rigs match fifty to six hundred ohms, and noting that a folded dipole presents a feedline impedance of three hundred ohms, they ground one side of the ribbon and feed the other from the coax output. This arrangement gets out swell, and until the first O.O. card arrives, they don't question the reason it gets out.

Perhaps this fault in our system could be legislated, but not at the Extra Class Level. If a prospective licensee had to submit a schematic of his complete station as a part of his examination, and were compelled to operate a home-made station for the first year of his license term, he would be better equipped to understand what goes on behind the shiny panel of that store-bought rig to which he aspires.

You warn us that in a couple of years we will have to face, across a conference table, a horde of new nations, hungry for broadcast frequencies, caring not a whit for amateur radio. So far as I have read, you have failed to convince us that what we do with the amateur service in this country will be any way affect their decisions.

ow was this matter of Incentive Licensing brought about? I have heard many complaints that not enough notice was given the amateur body to allow comments to be made. I read the "It Seems to Us" editorial in June QST, and the Highlights of the Board Meeting, and could not disapprove, in principle, with the stated objectives. It seemed as if my Extra Class License might at last bear some fruit, and I thought of how it was when we had Class A and Class B. After all, A PORTION OF THE HIGH FREQUENCY BANDS would be a suitable reward for a ham interested enough in furthering his understanding of "the state of the art" to pass an examination qualifying him for this reward.

Technically you stated this correctly—10 and 160 do constitute a portion of the high frequency bands, but I'll wager that a vast majority of those who bothered to think it over came up with the wishful thinking that you meant A PORTION OF *EACH* OF THE HIGH FREQUENCY BANDS.

Ten and One-Sixty indeed! If I were devoid of technical knowledge, from having been able to memorize the answers to questions on various examinations—a fault of the scope of the examinations, not of the examinee—if I were what Wayne Green terms an AO (Appliance Operator), I would seek a new and less complicated hobby. I fear that will be the result of this proposal, along with such fringe deficits as a loss of membership in the League, loss of business to manufacturers, and, in direct opposition to your stated objectives, a loss of activity in the public interest.

I hold little brief for the Conditionals, feeling that this class of license has been widely abused in the past. I know of those who would drive one hundred fifty miles for a shot at a deer, but would not drive eighty miles to take the General Class examination.

May I touch upon the matter of representation? I would not know Mr. Crossley if he knocked at my door. I imagine that, under the system as it was set up years ago, he is doing as well as could be expected at the job of representing this division. Perhops forty years ago a director could sample the feelings of a large portion of his division, but such is not the case today. I understand that a return of eight per cent is considered good for a questionnaire. That is a fault of our way of life. Wayne Green has proposed a grass roots system of communications which has possibilities of merit. *73* for September, 1963 outlines his idea, and I would suggest that you explore a bit along this line, and come up with an idea which would permit Mr. Crossley to be apprised of my feelings on League legislation before he casts his vote.

On the other aspect of representation, I have never felt that the League could truly state that it represents its claimed percentage of the amateur ranks, I am sure that, to many, membership means little more than a convenient Christmas present for the XYL to give, and I feel that if you were to include on the subscription form a statement such as:

I do (do not) designate the A.R.R.L. as my lobbying agent before the F.C.C.

you would know better exactly where you stand.

If, in closing, I may generalize, I am, gentlemen, disappointed, but not disheartened. I would be the first to shout the praises of all the League has done for me in the past, and I shall be equally vociferous in demanding that your thinking be cleansed of the "CW Forever" ideas, and directed towards thoughts as modern-day as is our shiny new Headquarters building. I shall not resign from the League, if only for the fact that my conscience would not allow me to criticize you in this manner, were I outside the fold. I ask only that you: 1. Assure me that T.O.M. rests in peace; 2. Review this matter of Incentive Licensing before we become unable to present a united front; 3. Develop a more progressive method of feeling my pulse.

H. E. Eddy W2SHZ

Procedure for Filing

If you are interested in letting the FCC know how you feel about things the process for filing is not really difficult. First write your letter or petition. Write this carefully, use a dictionary. Be sure that you make all the points you intend to in your letter. Refer the FCC to RM-499, the League petition.

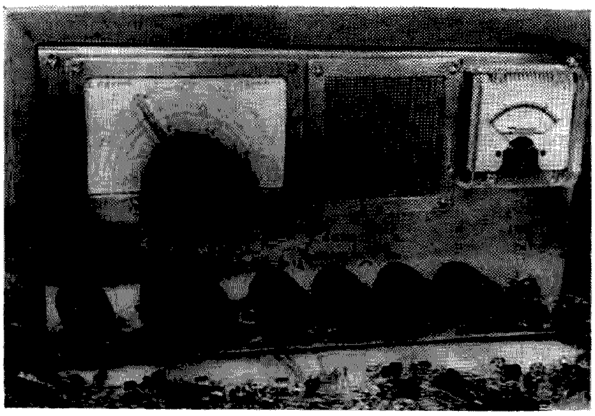
The next step is to prepare this letter and about twenty copies. The easiest way to do this is to find someone or a company with a duplicating machine of any sort . . . or a nearby print shop with a mimeo or small offset press. They'll give you the right masters to type on. Double space it, and leave generous margins.

Once you have your twenty copies send one to the ARRL, Newington, Conn., one to their council, Robert Booth Jr., 1735 DeSales St., Washington 36, D. C., one signed original with the notation (notarized) that copies have been sent to ARRL and council and 14 copies to the FCC, Amateur Division, Washington 25, D. C. You might send one to me for my files.

Reciprocation

Our reciprocation bill was passed by the Senate and now is up before the House as HR-7309 (nice number). The House will be arguing about all sorts of stuff so it is up to us to lean on them with all of the pressure we can muster. Write to Representative Oren Harris, Chairman of the House Commerce Committee requesting an early hearing and favorable action on HR-7309. Send a copy of your letter or post cards to your own representative in Washington. Let's back up Barry Goldwater and the other sponsors of this bill and get it made into law. Amateurs of all countries are the best peace agents in the world; many foreign countries have extended operating privileges to U. S. amateurs; let's be fair about this and take a giant step forward. Don't put this one off or leave it for the other guy, take a hand yourself in moving amateur radio ahead.

(W2NSD continued on page 70)



Eugene Franke W3HKX
734 Colebrook Rd.
Philadelphia, Pa.

A High Quality, Transistorized,

Communications Receiver

Transistorized communications equipment is becoming increasingly popular; however, the information available for building high quality receivers is scarce. It is possible to build transistorized equipment with performance comparable to that of its vacuum tube counterpart.

The dual conversion receiver described herein has the performance characteristics of a high-priced vacuum tube receiver. The receiver covers the amateur bands between 3.5 and 54 mc. Composite *agc*[1], which is used in this receiver, offers distortion free performance and better overload performance than any other system of *agc* presently used with transistors.

Other notable features of this receiver are: one micro-volt signal produces a 20 db or better signal-to-noise ratio on all bands; positive adjustable squelch is offered without sacrificing performance; the second *if* employs ceramic transfilters; voltage variable capacitors are used for fine tuning of the high frequency oscillator and bfo; the audio system delivers over one watt of undistorted output.

The small size and low power requirements make this an ideal receiver for both fixed station and mobile operation. The current drawn from a 12.6 v supply is: 16 ma when squelch is applied, 20 ma when headphones are used, 24 to 30 ma for low audio levels from the speaker, and up to 90 ma at maximum volume. The receiver operates on any external supply from 11 to 28 volts, ac or dc, or 110 volts ac.

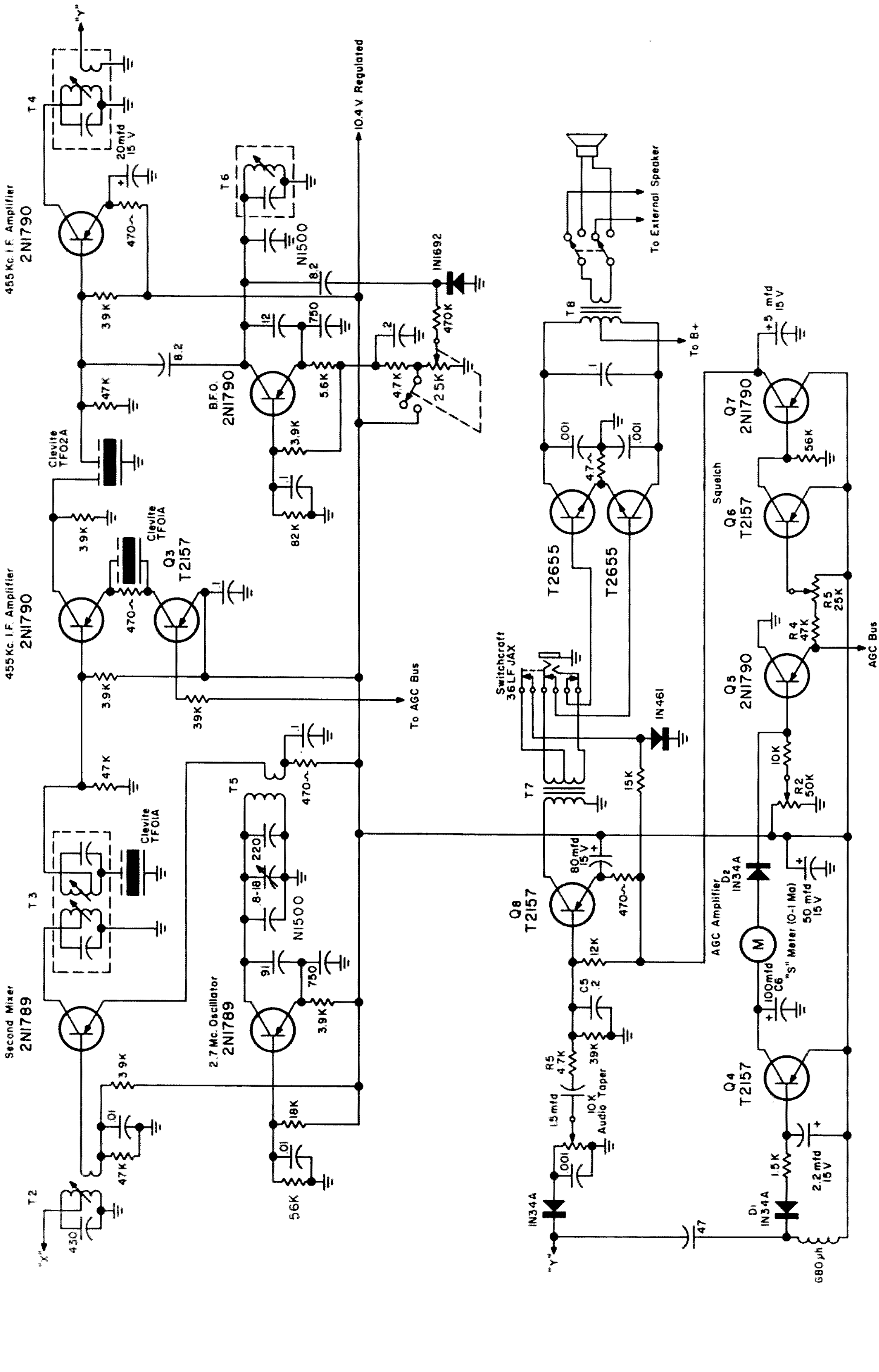
RF, Mixer, and HF Oscillator Stages

The rf stage was designed so it could easily be adjusted for tracking with the oscillator throughout each amateur band. Capacitive dividers are used with the input and output coils for impedance matching. This method of impedance matching does not offer optimum gain at all frequenices covered but since the transistor has ample gain, the ease of construction and alignment is well worth the sacrifice in gain.

For high sensitivity at high frequency, a high gain transistor is used in the rf stage. Because a high gain transistor is used, degenerating resistors, placed in series with the collector coils, are needed to eliminate the possibility of spurious oscillations which may appear at lower frequencies. A 39 ohm re-

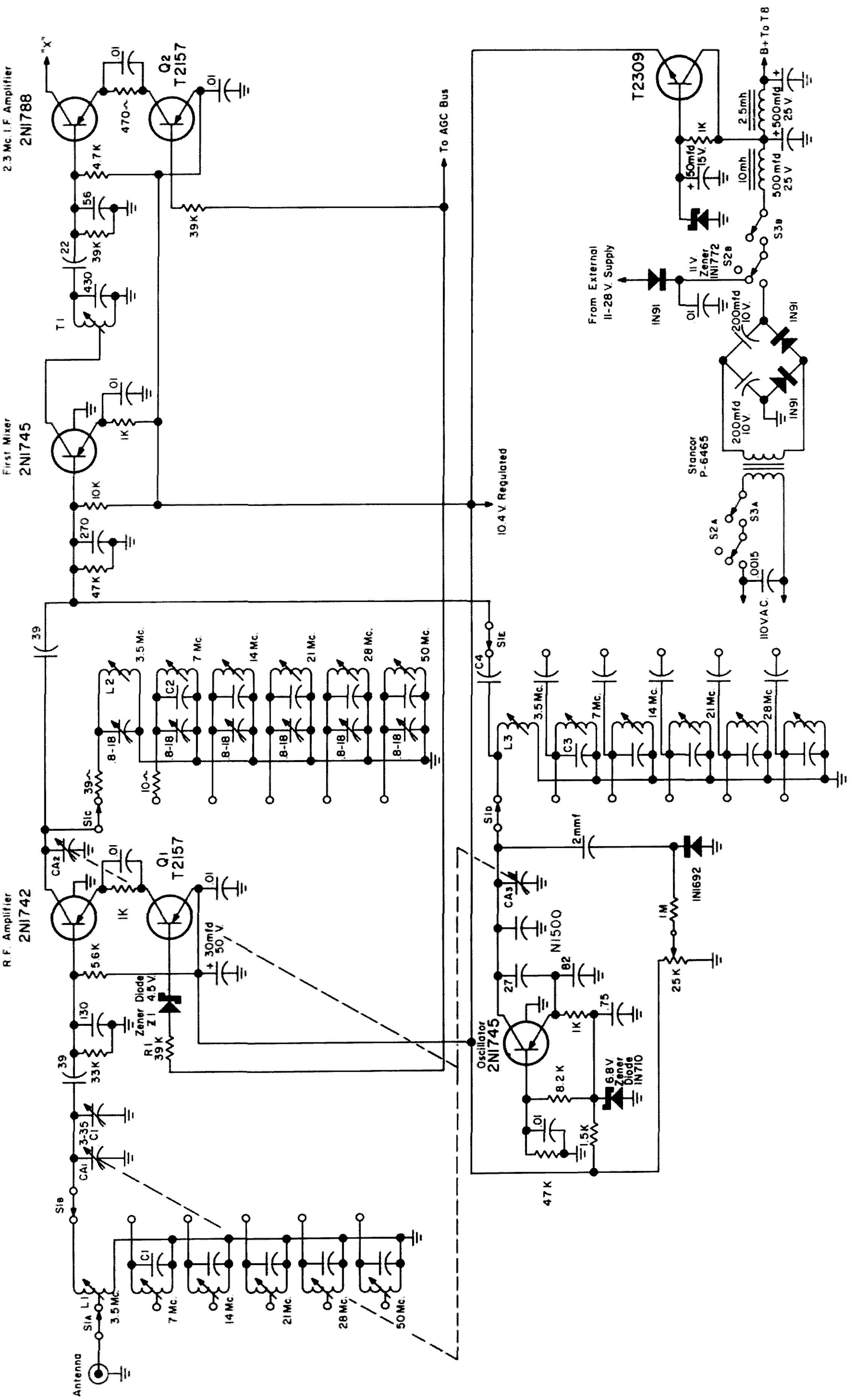
Fig. 1, pages 20 and 21
(Text continues on page 22)

C_1, C_2, C_3, C_4—See table 1
C_{A1}, C_{A2}, C_{A3}—3 Section variable 5-17 pf per section
L_1, L_2, L_3—See table 1
S_1—5 pole 6 position ceramic switch
S_2—2 pole 3 position switch
S_3—DPST switch (mounted on audio control)
T_1, T_2—11 uh, pri 34 turns #32 wire center tapped, sec 4 turns #22 on ¼ in. ceramic slug tuned coil form.
T_3—455 kc if transformer (Philco 32-4738-4)
T_4, T_6—455 kc if transformer (Philco 32-4738-2)
T_5—10 uh, pri 31 turns #32, sec 1 turn #18
T_7—pri 500 ohms, sec 500 ohms ct., (Lafayette AR162)
T_8—pri 350 ohms ct., sec 3.2 ohms, (X-5076 Columbus Process Co., Columbus, Indiana)
Resistances are in ohms.
Capacitances are in pf unless otherwise indicated.



Second Mixer
2N1789
455 Kc. I.F. Amplifier
2N1790
Clevite
TF01A
Clevite
TF02A
Q3
T2157
To AGC Bus
2.7 Mc. Oscillator
2N1789
N1500
T5
B.F.O.
2N1790
T6
IN1692
10.4 V. Regulated
20 mfd
15 V
T4
"X"
"Y"
T2
T3
Switchcraft
36LF JAX
T7
T8
T2655
To External Speaker
To B+
IN461
Q8
T2157
80 mfd
15 V
10K
Audio Taper
1.5 mfd
IN34A
AGC Amplifier
"S" Meter (0-1 Ma)
50 mfd
15 V
Q4
T2157
D1
IN34A
680μh
2.2 mfd
15 V
D2
IN34A
C6
100 mfd
Q5
2N1790
R2
50K
R4
47K
R5
25K
AGC Bus
Q6
T2157
Squelch
Q7
2N1790
+5 mfd
15 V

FIGURE 1


2.3 Mc. I.F. Amplifier
2N1788
Q2
T2157
First Mixer
2N1745
R.F. Amplifier
2N1742
Q1
T2157
Oscillator
2N1745
T2309
To AGC Bus
10.4 V. Regulated
From External
11-28 V. Supply
Stancor
P-6465
110 V.A.C.
B+ To T8
Antenna
Zener Diode
Z1
4.5 V
11 V
Zener
1N1772
6.8 V
Zener
Diode
1N710
1N91
1N1692
N1500
3.5 Mc.
7 Mc.
14 Mc.
21 Mc.
28 Mc.
50 Mc.

sistor is used in the 3.5 mc band and a 10 ohm resistor in the 7 mc band. It is impractical and unnecessary to neutralize the rf stage and all other amplifiers throughout the receiver since stabilization has been achieved by mismatching impedances. Transistor Q_1 provides *agc* for the rf stage; its operation is described later.

To minimize interaction, a separate oscillator and mixer are used. The oscillator is common base and uses a capacitive divider for feedback. The ratio of these capacities has been chosen to assure stable oscillation at all operating frequencies. Furthermore, a zener diode is used to regulate the oscillator voltage, thus ensuring that the oscillator will be independent of voltage variations.

The high frequency oscillator always operates on the high frequency side of the received signal making it unnecessary to change the frequency of the beat oscillator to receive single sideband signals when changing frequency bands.

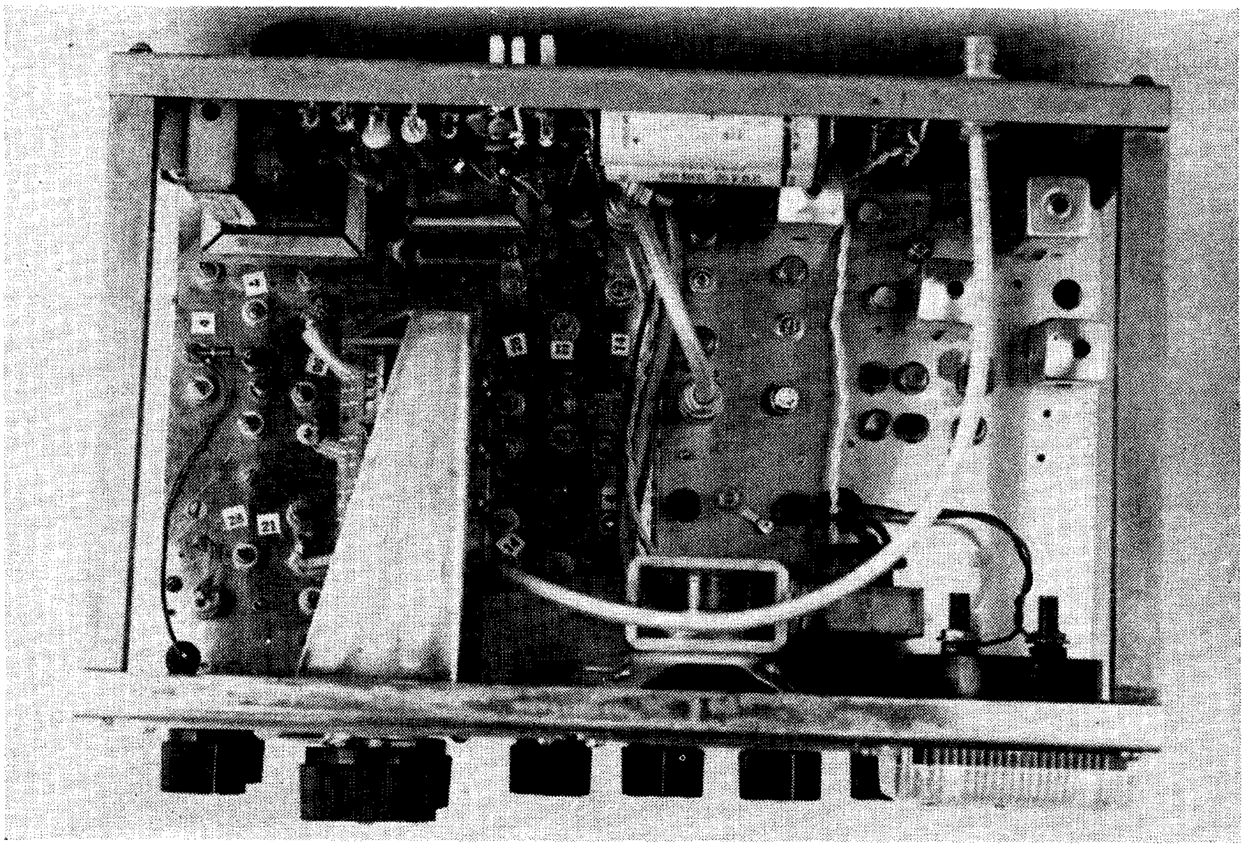
The voltage variable capacitor diode offers a convenient method of fine tuning. Its voltage control potentiometer is mounted in any suitable position while the diode itself is mounted near the oscillator. A small value of capacitance is inserted in series with the diode so the diode capacitance change produces only a small change in frequency. In this circuit, most of the RF voltage appears across the series capacitor. The Q of the series capacitor and diode is mainly determined by the Q of the small capacitor. Therefore, the Q of the diode can be quite low. Since all diodes exhibit this variable capacitance action, an inexpensive large area silicon diode will produce a sufficient change in capacitance to provide satisfactory fine tuning.

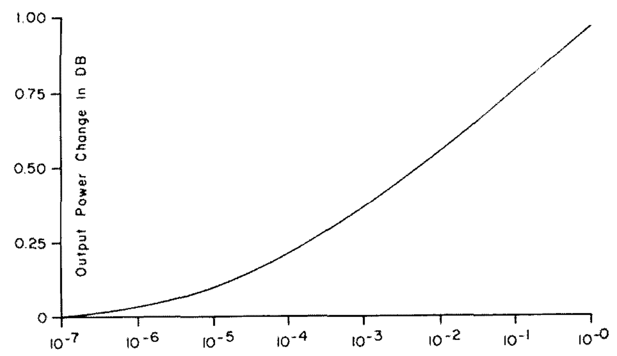
The mixer uses base injection. Either base or emitter injection could have been used, but in this case, the lead length necessary for emitter injection was great enough to cause mixer oscillation; therefore, it was better from a stability standpoint to use the former. For best noise figure and gain, approximately 150 millivolts of injection voltage is supplied to the mixer. The proper amount of voltage delivered to the mixer is determined by the series capacitor for each band.

Low Frequency Amplification

The first *if* frequency was chosen to give best results on the 14, 21 and 28 mc bands. An oscillator frequency of 2770 kc was selected so no harmonics of the oscillator could fall in any but the 50 mc band. The 19th harmonic falls at approximately 52.6 megacycles but is not detectable.

The second mixer uses emitter injection. A single turn around the grounded end of the oscillator coil couples energy from the oscilla-





Input Voltage Plotted Against Output Power
For 30 Percent Modulated 14Mc Signal

FIGURE 2

tor. This link is loosely placed so it can be adjusted to give 150 millivolts of injection.

The second *if* uses a ceramic filter in place of the conventional *if* transformer. This filter requires less space than an *if* transformer and can be mounted more easily.

The bfo transformer uses only the primary winding of a regular *if* transformer. An external capacitive divider is used to provide oscillator feedback. Although resonance can normally be obtained with this added capacitance it may be necessary to remove the internal 220 pf capacitor and resonate the winding with external capacitance.

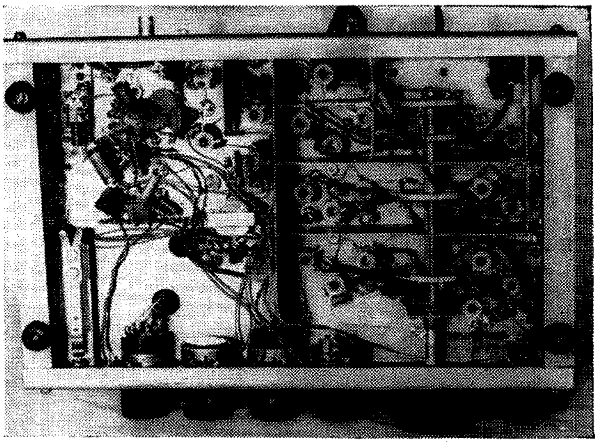
AGC

One of the problems with transistorized communication equipment is the difficulty encountered in providing automatic gain control. One method presently used is reverse *agc*. Reverse *agc* is accomplished by varying the bias to decrease collector current and thus reduce the gain. The major problem with reverse *agc* is that considerable distortion is introduced as the collector current approaches cutoff. Overload performance is very poor also. Due to the non-linearities of the base emitter diode, the voltage swing to the base should be much less than .1 volt to prevent extreme overload. Another method of *agc* is forward *agc,* but since this method is effective only at frequencies on the 6 db/octave slope of the transistor power gain curve, it cannot be used in this receiver so its operation will not be discussed here.

Composite *agc*[1], which is used in this receiver, does not have the frequency limitations of forward *agc* nor the distortion of reverse *agc*. Another desirable feature is the high input voltage overload characteristic. This technique of *agc* will be discussed in detail.

Transistors Q_1, Q_2 and Q_3 are *agc* control

[1] E. Franke, "AGC Design for Wide-Range Inputs," Electronic Design, PP 102-105, Nov. 8, 1962.



transistors. They function as a variable impedance in each amplifier emitter circuit. As the base current of the control transistor is varied, its collector impedance also varies. When the base current is high, the transistor is saturated and the collector to emitter impedance is approximately 25 ohms; thus, the amplifier transistor operates in the normal manner. When the base current of the control transistor is decreased its collector impedance rises and this rising impedance in the amplifier emitter circuit causes degeneration. When the control transistor becomes cut off, its collector impedance approaches 100,000 ohms. The amplifier emitter impedance will then be much greater than its collector impedance; therefore, most of the input signal will now appear across this high impedance. For this reason the input voltage is no longer limited by the transistor base-emitter diode. The amplifier collector current also becomes very low, causing a loss of gain. Because the high impedance is present in the amplifier emitter circuit, the signal is not distorted at low collector current. Due to degeneration, the benefits of reverse *agc* are realized without the distortion normally associated with it. When the control transistor becomes cut off, transistor action of the amplifier ceases and signal is transferred to the following stage by the resistive and capacitive components of the transistor. The input and output circuits should be well isolated to minimize stray feed-through.

To properly detect signals less than .1 microvolt, the gain of the rf and *if* stages must be high. In this case, the collector voltage swing of the final *if* transistor is several volts when a signal of .1 microvolt is received. For the receiver to handle an input signal of several volts, the overall receiver gain must be reduced approximately 140 db. To prevent overloading, *agc* was applied to three stages, thus providing ample control.

Composite *agc* offers greater gain reduction per stage and higher overload voltage handling capabilities than any other method of *agc* presently used with transistors. The gain of the 2.3 mc *if* can be reduced by 65 db. A 27 volt peak to peak signal can be applied to the base of the 2.3 mc *if* transistor before overload distortion occurs. The gain reduction of the *rf* stage is approximately 55 db on all bands.

The *agc* amplifier is a high gain dc amplifier, consisting of transistors Q_4 and Q_5, which is used to amplify the output of the *agc* diode D_1. This amplifier provides automatic gain control at any setting of the manual *rf* gain control. The necessity for this is that manual gain control is needed in receiving single sideband and in reducing certain types of interference. It may sometimes be desirable to tune for only strong signals, in which case the receiver gain can be low so most of the background noise is eliminated while tuning. When strong signals are encountered under these conditions, it is undesirable to have a considerable change in output. This method of *agc* insures that the receiver will not become overloaded

Table I

Band MC	L_1, L_2	L_3	C_1 pf	C_2 pf	C_3 pf	C_4 pf
3.5	40 μh 70 turns #32 tapped at 10 t	16 μh 40 turns #32				
7	3.1 μh 25 turns #26 tapped at 5 t	1.7 μh 16 turns #26	62	82	130	1
14	0.61 μh 10 turns #26 tapped at 2 t	0.32 μh 7 turns #26	130	130	200	3
21	0.22 μh 5.5 turns #24 tapped at 1 t	0.15 μh 4 turns #24	200	180	220	12
28	0.32 μh 7 turns #24 tapped at 1 t	0.20 μh 5 turns #24	30	30	56	12
50	0.15 μh 4 turns #20 tapped at 1 t	0.12 μh 3.5 turns #20	5	5	18	15

All coils close wound Formvar wire on ¼ inch ceramic coil forms.
L_1 tapped at indicated turns from grounded end.
L_2 same as L_1 except no tap.
Capacitances in pf, silver micas.

and is accomplished in the following manner: When the signal is not large enough to make diode D_1 and transistor Q_4 conduct, the voltage on the *agc* bus line is determined solely by the setting of the manual gain control, R_2. This voltage determines the receiver gain. If the signal becomes great enough for diode D_1 and transistor Q_4 to conduct, diode D_2 also conducts and the voltage on the *agc* bus line is altered to prevent receiver overloading. A meter in series with the collector of Q_4 is used to indicate the relative signal strength of the received signals. This meter should be calibrated with the *rf* gain control R_2 set for maximum gain (the most negative or ground position). In this position, maximum *agc* is applied to the amplifiers.

The gain control is applied to several stages to provide the best compromise among noise performance, cross modulation, and overload characteristics. To obtain good noise performance the gain of the *rf* stage should be high when weak signals are received. To avoid overloading other stages, the gain of the *rf* stage must be reduced as the signal increases. AGC should not be applied to the *rf* stage until the signal is great enough for good noise performance but it must be applied before overloading occurs in any stage. Specificially, *agc* of the *rf* stage should be delayed until the input signal is several microvolts.

The zener diode Z_1 in the base lead of the *agc* control transistor of the *rf* amplifier is used to provide delayed *agc* to this stage. When no signal is present, the *agc* bus voltage is approximately 10 volts. This voltage can be decreased to 6 volts before the gain of the *rf* stage is effected. As the voltage is further decreased the gain decreases quite rapidly until at 4.5 volts the control transistor becomes cut off. The cutoff voltage is dependent upon the breakdown characteristics of the zener diode. The amount of delay can be controlled by resistor R_1 and the zener diode Z_1 used in this circuit. At maximum input signal the minimum voltage on the *agc* bus line is established by the characteristics of the transistors in the *if* section. The additional voltage drop across the zener diode insures cutoff of the control transistor in the *rf* stage, thereby allowing it to handle higher voltage input signals.

The output power versus input voltage of this receiver is shown in Fig. 2. The output power is relatively constant for an input voltage variation of 140 db.

The time constant of the *agc* circuit can be changed by changing the value of capacitor C_6. The time constant will be longer as the value of this capacitor is increased.

Composite *agc* may be used with transistor types other than the ones used here. The main characteristics the *agc* control transistor should have are low saturation resistance when the transistor is on, a high voltage breakdown, and low voltage when it is off.

For those individuals not interested in composite *agc*, the receiver can be modified for reverse *agc*. The bias resistors of the *agc*'d transistors that are connected to the positive supply are removed and connected to the emitter of Q_5. The emitters of the *agc*'d transistors are then returned directly to the positive supply.

Squelch

Positive squelch is provided by transistors Q_6 and Q_7. Squelch is accomplished by removing the bias and supply voltage from the driver stage and the bias voltage from the output stage when a level of *agc* voltage, determined by the setting of R_3, is reached. Without Resistor R_4, the squelch control R_3 can be adjusted to provide positive squelch action at any input signal level from less than .1 μv to several volts. R_4 is used to allow easier adjustment of the squelch control but limits the maximum squelch level to approximately 50 millivolts (i.e., 60 db over S_9). Positive on-off action will occur with less than a 10% change in input signal regardless of the setting of the squelch control. For the receiver to remain on continuously, R_3 should be adjusted to the most positive position. The significant features of this squelch system are no sacrifice of receiver sensitivity and unlimited squelch level adjustment.

A germanium transistor may be used for Q_8 but the leakage current of these transistors is usually high and audio will leak through this stage. Q_6 may be replaced with a germanium transistor but temperature stability is sacrificed.

Audio

Transistor Q_8 is used as an audio amplifier for headphones and becomes the driver transistor for the output stage. The headphone jack removes the bias from the output stage when a plug is inserted. Headphones with an impedance of 600 ohms to 10,000 ohms may be used.

Since no essential speech information is contained above 4 kc it is undesirable, from a noise standpoint, to pass high frequencies through the amplifier. Resistor R_5 and capacitor C_5 are used to limit the high frequency response of the amplifier. The gain of the amplifier begins to decrease rapidly at 3.5 kc. The emitter of Q_8 is bypassed in the manner indicated to minimize hum. If the emitter were not properly bypassed, hum would be intro-

duced into this stage when the ac supply is used. This point is mentioned because individuals often incorrectly bypass the emitter of audio transistors and incorrectly assume the transistor is at fault for causing hum.

The silicon NPN audio output transistors do not run away thermally when delivering several watts of audio. It is unnecessary to use heat sinks on these transistors at this power level. If audio distortion is noticed, the last stage should be checked to make certain the transistors used can handle the voltage encountered. They must be capable of handling a voltage that is twice the supply voltage. If clipping of the audio is noticed, another set of transistors, which have higher breakdown voltage, should be substituted or transistors such as the T2309 or 2N2379 should be used. However, the T2655 (a matched pair) will usually prove quite satisfactory for supply voltages less than 20 volts.

Power Supply

The 6.3 volt filament transformer was chosen because of its small size. The supply output voltage is approximately 18 volts. A zener diode and transistor are used to provide a 10.4 volt regulated supply. Additional filtering is used for the audio output stage so no audio feedback occurs. The diode in series with the external supply protects the receiver in the event that incorrect polarity voltage is applied to the terminals. This diode is used as a rectifier when the supplied voltage is ac. The internal power supply has the added capability of supplying power for external high frequency converters used with this receiver.

Construction Considerations

Although this receiver is housed in a solid brass cabinet built by the author, it can be constructed in any available 6 x 11 x 7 cabinet. If the speaker were not mounted on the front panel, a smaller cabinet could have been used. To facilitate construction, the receiver was built on two chassis. One chassis contains the *rf* amplifier, oscillator, and mixer. The other contains the remaining circuitry.

The main tuning capacitor must be securely fastened to the chassis and mounted in a position to minimize feedback from the speaker. The shielding around the high frequency oscillator is rigid so that vibrations cannot cause frequency shift. Dual switch contacts are used for the band switch to insure positive contact.

The circuits used have been thoroughly tested. The receiver will operate with a 5 volt supply, though not quite as well. Although in several cases circuit functions could have been combined to lessen the number of components, no compromise was made to save components at a sacrifice of quality.

High frequency construction techniques, such as keeping component leads as short as possible and proper bypassing, are important. It is especially important to keep the leads of the amplifier emitters, *agc* control transistors and bypass capacitors extremely short.

This receiver is constructed using a negative ground. It is usually desirable to use negative ground when PNP transistors are used since it is possible to connect the collector coils directly to ground thereby eliminating a bypass capacitor and decoupling resistor.

Building a receiver of this type is a challenging and lengthy project. However, the long life and low price of transistors make it possible for the diligent individual to build his own high quality transistor receiver at a lower price than a vacuum tube receiver. The price of the transistors is less than $2 each except the *rf* transistor which is less than $3.

In conclusion, it is worthwhile noting that certain circuits in this receiver can easily be used to an advantage in other equipment. Of special interest is the composite *agc* system, the squelch circuit, and the audio section.

. . . W3HKX

Letters

Dear Wayne,

I enjoy your comments immensely. You were most generous to give Bill Orr W6SAI all that space to express views contrary to yours (and mine). He says hamming is not a hobby, but a service. By my new Webster's it certainly is a hobby, "An occupation or interest to which one gives his spare time." With which much of his argument falls in shreds. But it was in shreds already.

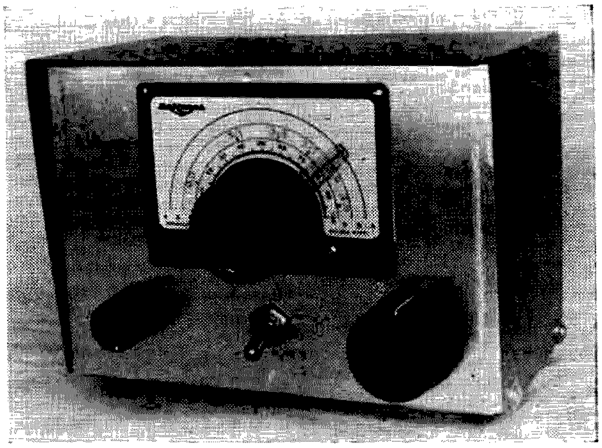
Carle Conway Jr. WA6TGC

Dear Sir:

Bill Orr said some things with which most of us agree, but he also said some which were, to be charitable, inaccurate. I believe that he has, through his article, placed himself in the same category as G. Crossley (ARRL Atlantic Division Director) who in one breath told a club that hams were no longer capable of constructing their own equipment and, in the next breath, informed them that he had purchased a new commercial transmitter for his use upon retirement. Another blatant example of preaching one thing and practicing another. May his spaghetti be filled with earthworms! Hi.

Karl Ayres WA2ANE

Fred Haines W2RWJ
Box 123
Liverpool, N. Y.



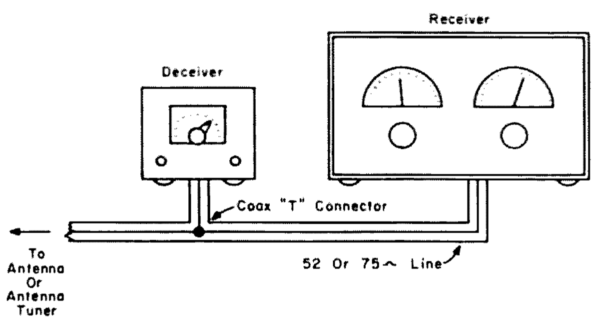
The Receiver Deceiver

Parts Kit Available

If your receiver is not designed expressly for SSB reception, the Receiver Deceiver will interest you. It is a simple yet highly effective device to provide you with improved SSB reception. It is completely independent of the receiver and does not require any modification to the treasured squawk box. This is extremely important if the receiver is to be traded in some day toward more modern gear.

The principle of the Receiver Deceiver was discovered accidentally by the author one evening last winter, but upon investigation it was found that the idea is not original. It has not been used previously, however, in this form.

I had decided to build an experimental transistor oscillator to check out the stability of transistorized VFO's. The low-powered circuit was set into operation on the work bench and the station receiver was turned on to aid in calibration of the tuning range. The receiver was set near 4 mc and some SSB stations were heard in the background. The oscillator was tuned through them and they suddenly became intelligible! It was too obvious to be an invention in the true sense, but it worked well. In a nutshell: A low-powered local oscillator near the receiver to inject a carrier for the demodulation of SSB signals. After some study of the available literature it was decided that this method of SSB reception had some very definite advantages over the BFO injection system. This has been born out in practice.



As with most ideas, there were some pitfalls in reducing it to practice. It was soon discovered that since the oscillator strength could not be varied, and owing to a lack of shielding, the carrier injection was much too strong. The oscillator was then rebuilt in a shielded box and followed by an emitter-follower transistor having a gain control in its emitter. A trial of this arrangement brought to light a basic limitation of transistors. When a cathode-follower tube is used, it provides practically perfect isolation between an oscillator and its load. The transistor was revealed as a two-way device! That is, any slight variation in the load such as that caused by turning the gain control, was reflected back through the emitter-follower, causing an intolerable shift in the oscillator frequency. Even three cascaded emitter-followers were tried and didn't completely remedy the situation! At this point it was decided that solid-state physics was obscuring the original idea, and a shift to vacuum tubes was in order. A coward you say? O. K., then try it for yourself!

Suffice it to say that many breadboard models were built before the final circuit jelled. Many problems were solved incidental to determination of the correct output level,

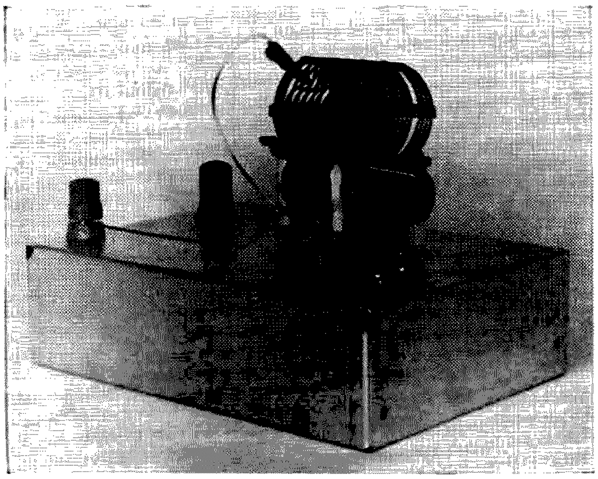
effective shielding, power-lead by-passing, and even working out a technique for mixing the carrier in the antenna circuit, at low impedance level, ahead of the receiver.

Basically the circuit is a very low power oscillator, a 6C4, driving a cathode-follower, another 6C4, serving as isolator and gain control buffer. A dual triode was tried in the hope of making the Deceiver a one tube circuit, but coupling due to proximity within the single envelope allowed the oscillator signal to leak past the gain control stage. The unit is equipped with a main tuning dial, calibrated for the bands 80 through 10, and a vernier tuning control (phase control) allowing fine adjustment of voice pitch. Harmonics of the 3.5 to 4.0 mc range are strong enough to allow reception on the higher frequency bands. The carrier amplitude control is used to match the strength of the injected carrier to the strength of the incoming sideband for optimum results.

It is not claimed that the device allows better reception than a receiver equipped with a product detector; this is obviously impossible. What is claimed is that it will give much improved reception with receivers using the BFO carrier injection system. The standard method of tuning single sideband with a BFO is to turn off the AVC, turn the audio gain up full and lower the *rf* gain as far as possible. This is done for two reasons:

1. The BFO will overload the AVC system.
2. The injected carrier must be large with respect to the incoming signal.

The idea is that if the *rf* gain is turned way

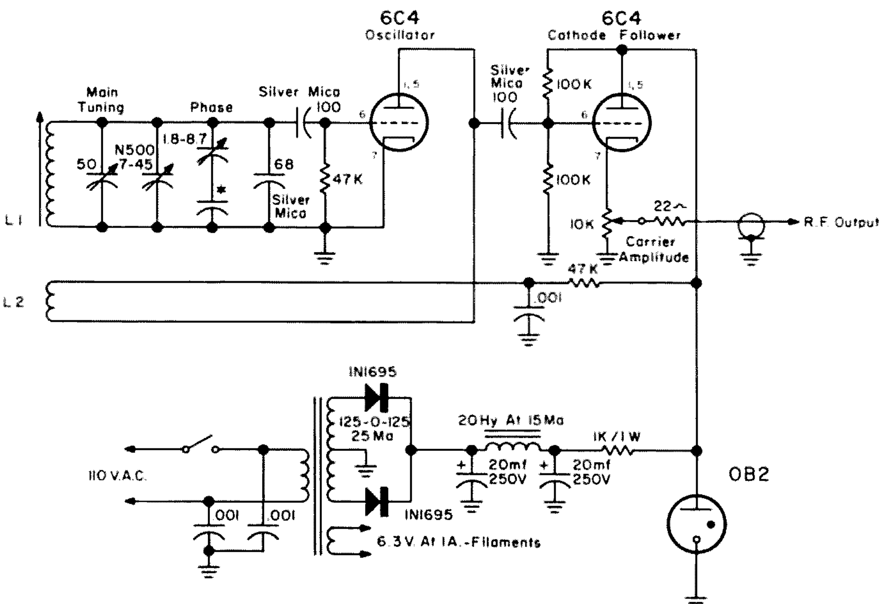


down, the signal at the diode detector is small, thus increasing the *relative* strength of the BFO injection. Unfortunately, most receivers have too weak a BFO to give best results even with the *rf* gain near minimum.

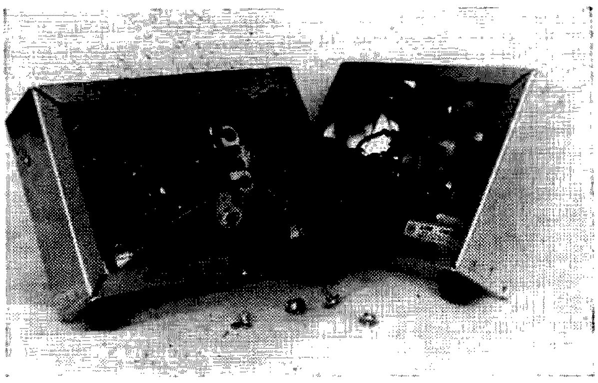
The Receiver Deceiver allows operation with the *rf* gain at maximum and the AVC on if desired. The receiver is deceived into thinking it is picking up a normal am signal and its adjustment is the same as always! One of the advantages of the Deceiver is that the receiver tuning dials may be adjusted at will, and peaked up perfectly without affecting the voice pitch.

The photos illustrate the general construction plan used by the author. The shielded enclosure is made of two 5"x7"x2" aluminum chassis mounted bottom-to-bottom, held together by the four screws through the inverted U-shaped cover. The oscillator is mounted in the front chassis with the regulated power supply in the rear one. Interconnections between the chassis are made with 6-inch lengths of flexible wire to allow access for servicing. Small aluminum L-brackets serve as tube socket mounts and the main tuning capacitor is secured to an aluminum brace spanning the front chassis from top to bottom. The exact construction method is not important except that *rf* shielding must be good and the general rules for stable oscillator construction must be followed.

The only satisfactory method of mixing the output with the incoming sideband at the receiving antenna was found to be at low impedance, say 50 to 75 ohms, and completely



* #20 solid plastic insulated wire, twisted together ½".
† Johnson type 160-104.
L2 — 9T #26 enam. wound on L1 form at bottom end.

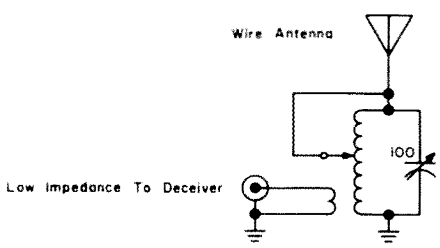


shielded. This dictates the use of a coax fed antenna. If an end fed wire antenna must be used, then it is required that a receiving type antenna tuner or a Balun be constructed to convert the signal to low impedence. The circuit shown is one which worked well at this station. The coil is a modified B&W 75 watt plug-in coil, but a 25 watt coil or piece of Miniductor could also be used.

To align the Receiver Deceiver, a calibrated receiver, preferably with a 100 kc standard, is required. Allow the receiver and the Deceiver to warm up for at least 15 minutes before proceeding with the job.

With the cover of the Deceiver off, determine if the oscillator is functioning by listening for it in the receiver. A signal should be heard somewhere in the 3 to 5 mc range. Now set the receiver accurately to 4.0 mc and set the Deceiver dial to the end corresponding to minimum capacitance of the capacitor. Adjust the 7-45 uufd ceramic trimmer until the Deceiver is putting out a 4.0 mc carrier. Note that you will have to place the halves of the chassis together in order to hold the stray capacitances to the values they will be at with the cover on.

Now tune the Deceiver dial to maximum capacitance. If the unit is now oscillating at 3.5 mc you are the luckiest home-brewer on the planet! If it is not, juggle the settings of the slug-tuned coil, and the ceramic trimmer until the tuning spread is 3.5 to 4.0 mc. The



ANTENNA TUNER FOR RECEIVER DECEIVER

L & C to resonate at 80 M (entire coil) and 40 M (½ coil).

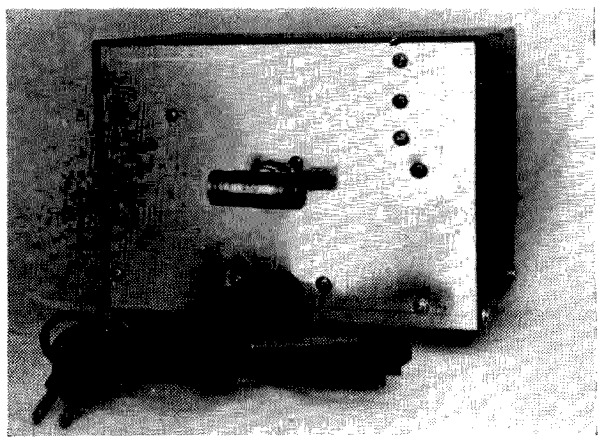
cover may now be put on and the calibration re-checked. If it is correct, calibrate the dial for the bands you wish, and install the unit near the receiver with the coax antenna lead looped through the Deceiver with a coax TEE connector as shown in the diagram.

Operation of the Receiver Deceiver is simple, certainly no more difficult than tuning in SSB with a receiver and BFO. Set up the receiver as follows:

1. *rf* gain on full
2. *af* gain at normal for *am* reception
3. *avc* on
4. *bfo* off

Set up the Deceiver as follows:

1. Carrier amplitude control ¾ clockwise
2. Phase control straight up (½ full capacitance)
3. Main Tuning to approximately the frequency of the incoming sideband.



Peak up the receiver for maximum monkey chatter, and then carefully tune the tuning dial of the Deceiver for intelligibility of the signal. The S-meter will indicate when the Deceiver is tuned near the signal frequency. Once the signal is tuned, the Deceiver *phase* control may be used to trim up the voice pitch as the station frequency drifts up or down the band.

Once you have placed the Deceiver in operation and experimented awhile, you will note several advantages. For example, after tuning in a SSB sig, the receiver bandspread dial may be tuned and peaked up without affecting the voice pitch. The advantage here is that the crystal filter and notch filter can be used to better advantage. The signal can be positioned in the passband as required to eliminate interference without affecting the voice pitch. This is virtually impossible with the BFO injection system.

Another Deceiver advantage is that the carrier injection can be varied from about S1 or

S2 to almost pinning the S-meter. If you will experiment with the carrier injection you will see that there is an optimum carrier strength for weak and strong signals. It will be found that strong AM signals near the desired SSB signal will not ride through as much if the carrier injection is increased past a certain point. It is fascinating to turn down the injected carrier and note the point at which the signal becomes unintelligible.

A bonus advantage is that the drift of only *one* oscillator will affect the voice pitch of the signal. With the BFO method, drift of the local oscillator and the BFO oscillator will cause unstable reception. With the Deceiver, only *its* drift is a factor, and this is relatively small.

When the BFO injection method is used the *rf* gain must be set to a low point, resulting often in a poor signal-to-noise ratio of the first *rf* stage. The required high setting of the *af* gain often results in a large hum in the signal, because most receivers are not designed to operate with maximum *af* gain. Use of the Deceiver eliminates these problems too.

One word of caution is in order here . . . Do not give out any signal reports based upon your S-meter readings! The reading derives entirely from the Deceiver output signal and can be set to any point desired.

If you turn in your present receiver for one designed for SSB reception, you can use the Deceiver as a stable VFO to drive a transmitter. Followed by a class A stage it should give a good account of itself in this service. It would be best in that case to remove the 47K resistor in series with the oscillator plate circuit to increase the output level. A 1000-ohm resistor would be about right.

If the Deceiver puts out too much or not enough signal for your receiver, adjust the value of the series plate resistor. If it is made too large, the oscillator will not operate, however. The plate of the oscillator measures about 25 volts dc with the 47K resistor shown.

. . . W2RWJ

Parts Kit Available

A complete kit of parts for this project is available for **$19.95.** (Bargain)

73 Peterborough, N. H.

Let's Keep it Simple

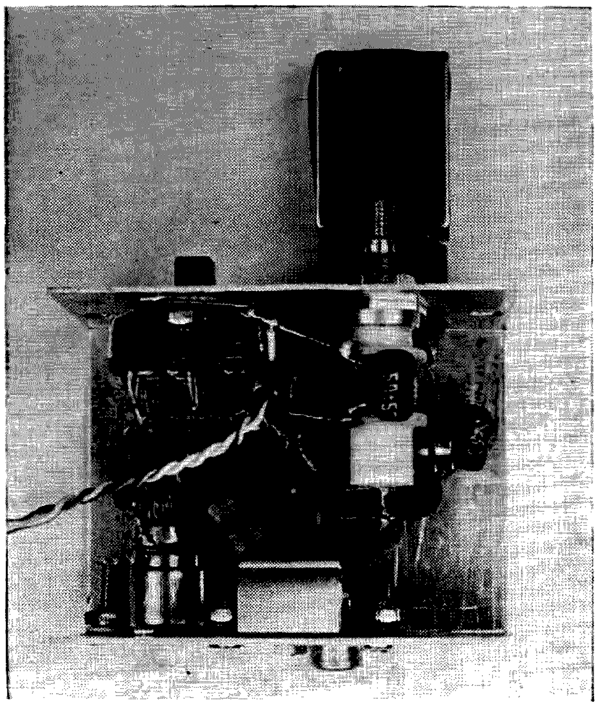
M. P. Hughes VE2AUB/W5
Box 547
Fort Davis, Texas

Parts Kit Available

Are you tired of the "Goo for You" that blares from your car radio? You are? Would you prefer to listen to your favorite (HF) ham-band? You would!—Then read on, because you *can* for a meager $10 outlay.

The unit described here is a transistorized converter that operates from a self-contained mercury battery and can be used with the standard automobile broadcast whip. Fig. 1 shows how simple the device really is, and the photograph illustrates the way it looked before the circuitry was finalized.

Things may look a little strange in the circuit at first, but its operation is quite straightforward. Fundamentally it is a grounded emitter amplifier with a crystal and capacitor added in series between the collector and base. The 100μH choke is essential to make the circuit oscillate, since the car radio input presents too low an impedance to sustain oscillations; at broadcast frequencies, however, it has only a minor effect. The circuit is there-



fore that of a self-excited mixer in which the oscillatory circuit is a Pierce. The parallel tuned circuit L1 C1 resonates in the band of your choice (see table 1), and the crystal is chosen in accordance with table II. The unit works quite well using up to the fourth harmonic of the crystal, and in most of the tests surplus FT243 crystals were found to be quite satisfactory.

Almost any good *rf* transistor will prove suitable in the circuit, provided it is operated within its frequency ratings. The 2N 1742 (Philco) is recommended as an excellent transistor to use. However, if you have a spare 2N 247 (now obsolete) it will work perfectly well.

The transistor is tapped down the tuned circuit and the same tap serves also for the antenna coupling—a compromise that seems to work out quite well. R1, R2, and R3 form the bias network for the transistor, and in the set-up procedure R1 may be adjusted for optimum performance. The 2.5mH choke is the load at broadcast frequencies. A three-pole-double-throw switch, S1, is used to change from normal broadcast to ham-band reception. One pole of the switch connects the input of the broadcast receiver to either the antenna or to the output of the converter. A second pole connects the antenna to the converter, and the third pole switches the supply voltage to the transistor on and off. J1 is an automobile radio coaxial receptacle for the antenna input, and J2 is a phono socket for the *if* output—of course these connectors are not mandatory, and you can use other types that suit your particular installation.

The converter illustrated in the photograph was built in a 2¾" x 2⅛" x 1⅝" minibox. The switch, coil, and crystal socket are mounted on the front panel. The rear panel supports the coaxial receptacle J1 and the phono socket J2. A clip, also on the rear panel, holds the mercury battery (not in the photograph because it casts an annoying shadow). The resistors and 100μh choke are mounted on a piece of Erie

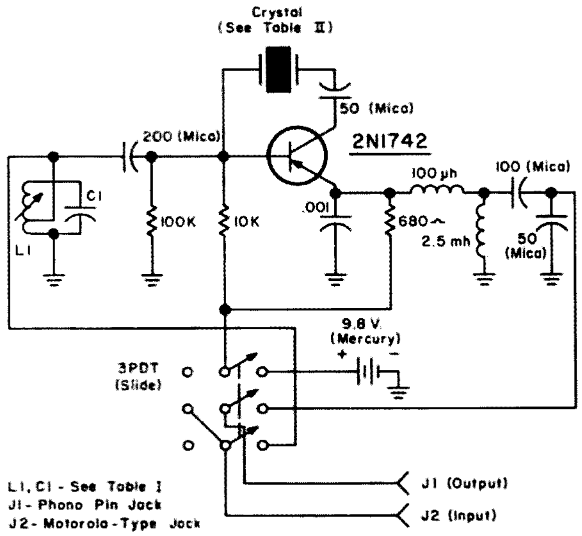


FIGURE 1

"strip package" terminal strip. Since the layout is not critical, almost any arrangement that accommodates all the components would be satisfactory, but it is advisable to keep the coupling between the coil and chokes to a minimum.

The coil is mounted on the front panel so that it can be easily adjusted to peak signals in a part of the band remote from that normally used. For most purposes it is unnecessary to change the tuning of the coil after the initial set-up procedure, since the circuit is broad enough to permit operation over one or two hundred kilocycles without impairing the sensitivity to any great extent. On ten meters (are there any signals there these days?) it might be advantageous to use a variable capacitor in the circuit if frequent qsy across the band is contemplated.

When the unit is complete, check it very carefully for wiring errors and if you are certain that no such errors exist, connect the mercury battery. With no crystal plugged in, check the total current being drawn. If it lies in the range 0.5 to 2.0 ma, then all is well. In the unlikely event that it lies outside this range, R1 may be changed to bring it near 1 ma. Low current can be corrected by decreasing R1, and high current by increasing R1.

Now feed the output of the converter into the homestation receiver and tune to the band for which the converter has been built. Connect an antenna to the converter, switch on and adjust the slug of L1 for strongest signals, using the converter as a preamplifier for the moment.

When the signals are peaked, tune to the chosen crystal frequency (table II), plug in the crystal and check for stable oscillation. If you do not have a general coverage receiver, you can see if there are oscillations by taking hold of the crystal or by touching the collector of the transistor while watching the collector current. The current should vary as these tests are performed. On the other hand you can skip this test and go straight to the following one.

Tune to the broadcast band or connect the output of the converter to a broadcast receiver, switch on, and take your fill of the qrm. At this stage it is just as well to check that the coil is still correctly tuned.

In the car, if a resonant antenna is not available, the converter uses the standard broadcast whip. Just unplug the coax from the input to the broadcast receiver and plug it into the antenna input, J1, of the converter. A piece of coax (preferably low capacitance type, e.g. RG62U or RG63U) with a phono plug on each end is used to connect the converter to the car radio. (Phono plugs fit quite well into the receptacles on car radios.) The length of this piece of coax will be dictated by the location of the converter in your particular installation. If you intend to use the broadcast whip as the antenna, make sure the coax will reach the proposed mounting position.

The author has a multi-band version of this unit mounted under the dash in his car. Band changing is accomplished by switching at point "x" in Fig. 1, and plugging in suitable crystals. A negative ground was used so that in case of emergency, or if the mercury cell failed, connection to the car battery would be simplified. It was decided to include this fea-

Table I

Band	L1, turns	Tap, turns from ground end	Wire gauge	C1 mmF
3.5	40	10	28	175
7	20	5	28	100
14	15	4	22	75
21	10	3	22	50
28	7	2	22	30

All coils close wound on standard slug tuned ⅜" diameter forms.

Table II

Band	Forward tuning Crystal Freq. Mc/s Highest Lowest	Reverse tuning Crystal Freq. Mc/s Highest Lowest
3.5 - 3.8		4.7 - 4.4
3.8 - 4.0		5.0 - 4.6
7 - 7.3	6.4 - 6.1	8.2 - 7.9
14 - 14.35	13.4 - 13.15	15.2 - 14.95
21 - 21.45	20.4 - 20.25	22.2 - 22.05
28 - 28.5	27.4 - 27.3	29.2 - 29.1
28.5 - 29.0	27.9 - 27.8	29.7 - 29.6
29.0 - 29.5	28.4 - 28.3	30.2 - 30.1
29.5 - 29.7	28.9 - 28.5	30.7 - 30.3

Crystal frequency can be a harmonic.
Highest frequency on receiver dial limited to 1200 kc/s to avoid effect of 100µH choke.

ture in the converter described here. When the multi-band version was built, no 3pdt switch was available, and so a dpdt plus a spdt switch were used to do the job. Of course, one of the dpdt switch poles could have served a dual purpose . . . but let's keep it simple. . . . VE2AUB/W5

Parts Kit Available

A complete kit of parts for this rig is available at the low price of **$6.95.**

73 Peterborough, N. H.

Going RITTY

Fred DeMotte W4RWM

There are two questions which are always asked by the Amateur who would like to give RTTY a try, and the answers on the whole have been answered in such a manner as to discourage many who would otherwise give the mode a try.

First, one hears, "it is too expensive." Second, "it is too technical." And as a discouraging clincher, "can't get any equipment."

There has been a great deal written about all three of these questions and the ones that floor most amateurs are those that start off with "RTTY is expensive but . . ." and "a higher degree of technical skill is required." Many articles that use these lines for leads, do more to turn amateurs away from RTTY, than any other thing.

The fact is that "going RTTY" is one of the lowest cost layouts that an amateur can own.

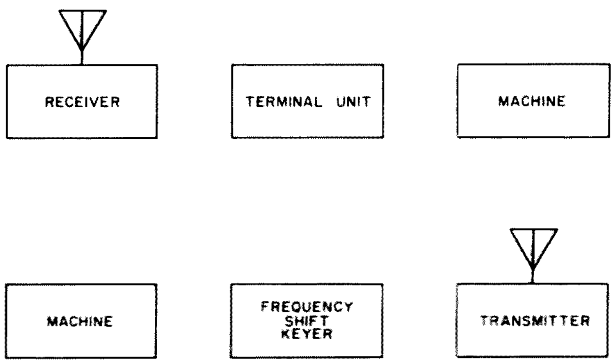
The average amateur has a considerable sum invested in a good commercial transmitter and receiver, plus the auxiliary equipment he has acquired.

These items run as a rule to almost $1,500 per amateur station, so if we use this as a yardstick we find that adding RTTY is only a drop in the bucket to what he has already invested.

Now let's take the statement, "it is too expensive," and see just how much it does cost to get on RTTY.

Let me use the first RTTY installation set-up in the writer's station.

It consisted of a model 26 machine and table for which I paid $50, a home built terminal unit, parts taken from my junk box, and as I recall, none too close to schematic specifications, which cost, as a result, about $5. If you had to purchase most of the parts, it would



not be over $30., and the FSK Circuit made from old spare parts cost nothing. If the parts were purchased today, they would cost a couple dollars.

Quick addition will show then that I went RTTY for $55. plus a little construction time.

Of course I had a Navy TCS Transmitter and an old RME 45 Receiver already and since it is assumed that the transmitter and receiver are already part of the station, they cannot be counted into the total cost of getting on RTTY.

That $55. is a long way from those remarks that justify, "it costs so much," for compared to the investment already made, it is only about the cost of attending a weekend hamfest.

If you think that it still cannot be done today for this money, I would say that Model 26 machines are available from time to time for under the fifty dollar figure I paid and terminal units can also be purchased for a very low figure or built from spare parts.

Of course, as with all models, the expenses involved will depend upon the interest of the individual who will demand more equipment, as his interest grows. This is true of any phase of the hobby and should not, however, be used as the basis for the stock answer—"it's too expensive."

Now let's look at the second bugaboo—"it's too technical."

You have a receiver and you have a transmitter and you know how to use both and you know that this does not require a great deal of technical skill.

Now let's apply it to receiving and sending RTTY signals.

Let's look at the receiving side first.

You need the receiver, a terminal unit (converter) and a teletypewriter. The block diagram shows their places in the circuit.

Since you are familiar with tuning a CW or SSB signal which requires your being familiar with BFO adjustment, you should have no trouble tuning a RTTY signal which is nothing more than a steady carrier, being shifted in frequency 850 cycles, by the transmitting station. This produces a two tone audio signal from the receiver output and feeds this to the terminal unit, which converts these audio signals into d.c. pulses which then are fed to the machine, operating the selector magnets on the machine, producing the printed characters being transmitted.

If you can connect equipment together in proper sequence, you will find nothing complicated about it and if you can build simple circuits, it will be a cinch.

Now let's take the transmitting end of the story. Here again a block diagram shows the lineup. A lot will depend on the type of transmitter you have, but nearly all can be made to operate RTTY with FSK or AFSK.

Take the old TCS I started with—only thing I had to do was run three wires to the base of the oscillator tube, one went to the cathode and the others were to pick up filament voltage for the 12H6 diode I used. That's all there was to it.

The FSK circuit was simple, consisting of a 50,000 ohm pot, a 2.5 mh RF choke, two .005 condensers, a octal socket, the 12H6 tube and a small slugged tuned coil form ½ inch in diameter, wrapped with 20 turns of #22 wire, so you will understand that if I could have done it without any extra technical knowledge on the subject, it does not take a radio engineer to do it.

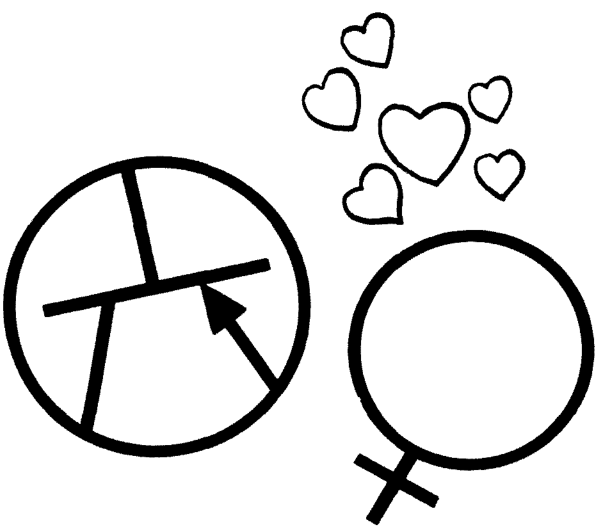
Feeding this frequency shift keyer, to the cathode of the oscillator causes the frequency to be shifted, according to the amount of inductance inserted into the oscillator circuit.

The adjustment of the 50,000 ohm pot in this particular circuit governs the amount of shift and should be set up for 850 CPS.

That's all there is to it, except to add, in answer to "can't get any equipment" that you should contact any RTTYer near you or, better yet, join one of the RTTY societies, who will be glad to assist you in getting machines and giving advice.

Don't let those articles that start off with "it's too expensive" etc. scare you off—for you can get on RTTY for under $100.—easily.

. . . W4RWM



Wayne Pierce K3SUK

Well Grounded

Richard Genaille K4ZGM
719 Quarterstaff Road
Winston-Salem, N. C.

One of the most neglected areas of the average "ham" station installation is the antenna ground system and yet, in almost all cases, it bears equal importance with the antenna itself as far as the radiation of the transmitter output is concerned. Did you know that, without a good ground system, the effciency of a ¼ wavelength vertical antenna may be as low as 50%? If the antenna height is less than ¼ wavelength the efficiency may be even less than that. At this point the advocates of horizontal antennas are probably all muttering, "I told you so." They are almost as bad off as the proponents of the vertical antenna when you realize just how important a ground system is to the operation of any antenna whether it is a horizontal or a vertical.

One of the most probable causes for the lack of attention to the antenna ground system is that one can connect almost any sizable metallic object to the antenna output terminals of a transmitter and manage to radiate a signal. This possibly accounts for the success of many of the weird antennas that have appeared in recent years that seem to function for no good reason other than they are metallic objects. Almost everyone has heard, at one time or another, of hams who have worked into the next state or have worked DX when using a floor lamp as a dummy load on the transmitter. There have been many cases where bedsprings and other sundry metallic objects have been used for the radiation of rf energy with some success. Needless to say, even the most inexperienced operator knows that he needs something better than a bed-spring to communicate effectively with other stations. A second probable cause of indifference toward antenna ground systems is that the majority of antenna distributors and authors of articles describing antennas say very little about the antenna ground system, leaving it pretty much up to the individual. A casual mention of a ground or the ground symbol on a diagram of an antenna system does not mean a ground stake or a simple water pipe ground. What it does mean is a perfectly conducting ground and not one with high enough resistance to dissipate a large amount of your transmitter's power output in the form of heat instead of radiated rf energy. A third quite likely cause is the work involved in fabricating and installing a good ground system. It can be said that a good ground system will, in almost all instances, result in improved performance and efficiency of your antenna system. Before we

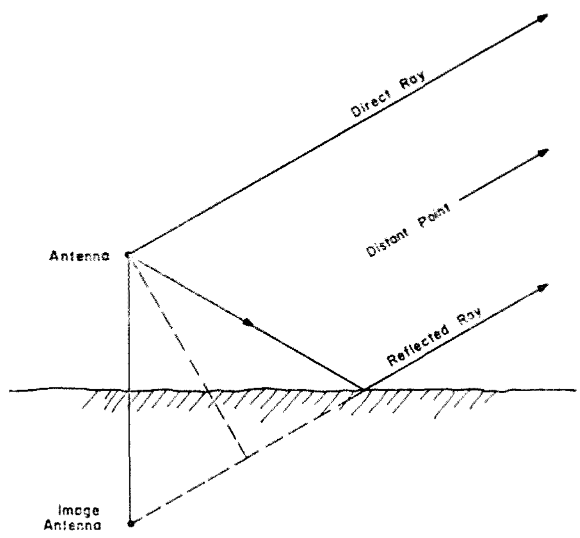


FIGURE I

Reflection is similar to that of light waves reflecting from a mirror. A poor ground will cause considerable attenuation or complete absorption.
Effect of Reflection From Ground.

get into the practical aspects of installing a good ground system let's see why a ground is so essential for the efficient operation of both the horizontal and vertical antenna.

It is more than likely that the first discussion concerning antenna operation given in any good antenna handbook or manual is how the operation of an antenna is affected by ground. The proximity of earth to the antenna will modify, to a great extent, the directive properties of that antenna. The usual graphic presentation showing the reflection of rf energy from the ground to aid or oppose radiation in a given direction is shown in Fig. 1. The effect of this reflection is often expressed as a factor and normally appears in graphic form as shown in Fig. 2. The reflection factor graphs have been made up for various antenna heights for both horizontal and vertical antennas. In almost all

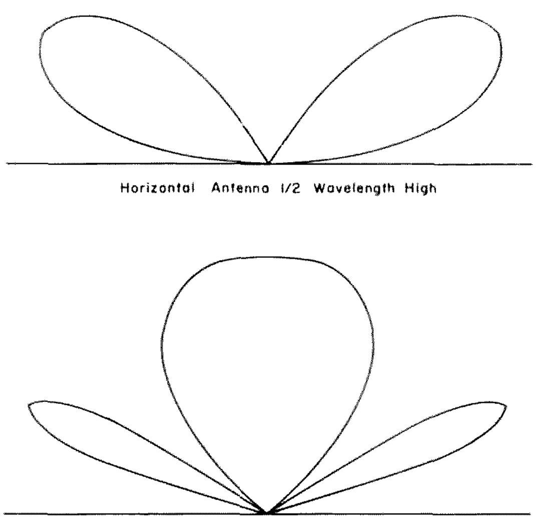


FIGURE 2

Variation in Reflection Factor Over Perfectly-Conducting Ground.

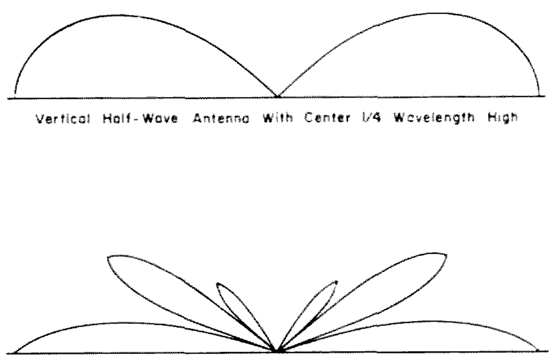


FIGURE 3

Variation in Vertical-Plane Radiation Pattern Over Perfectly-Conducting Ground.

cases the graphs are based on height above and reflection from perfectly-conducting ground. Ultimately, for more practical use, we have available any number of graphs showing the vertical-plane radiation patterns for horizontal and vertical antennas. These are depicted in Fig. 3. These graphs are also based on the antennas being located above perfectly-conducting ground. In a very few instances charts and graphs are found that are based upon ground of average conductivity. In these cases the conductivity and dielectric constant of the ground will be indicated. The vertical-plane radiation patterns are used, by the more proficient operator, to assist him in directing the rf energy from his transmitter to its ultimate goal. The pattern tells the operator that he must place his antenna at a certain height to obtain the coverage that he wants, whether it be low angle radiation for DX or higher radiation angles for more local coverage. The vertical-plane radiation patterns are used, together

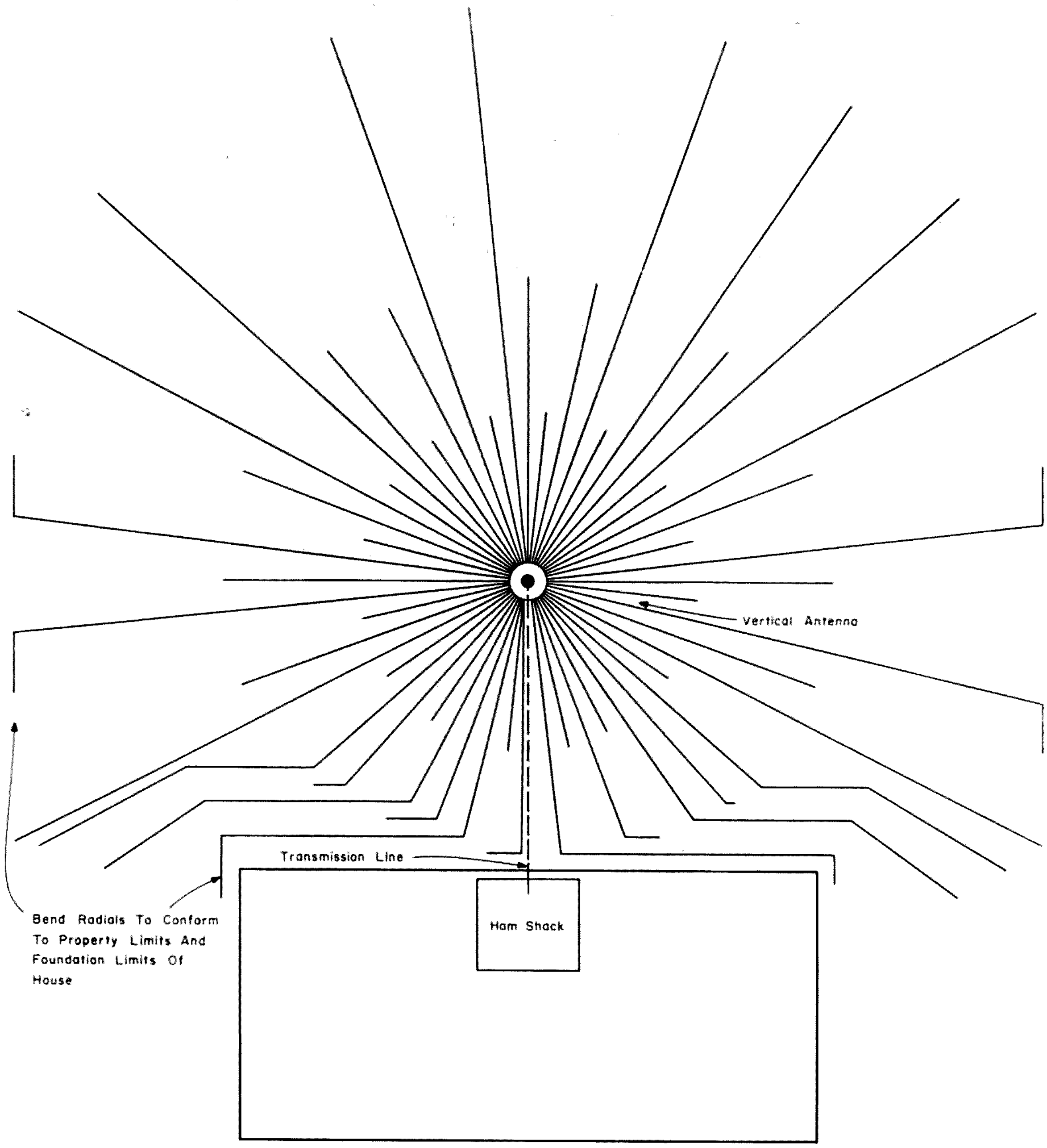


FIGURE 6

Typical Antenna Ground System Layout For Vertical Antenna Centrally Located in Front or Rear Yard. Ground System Connected to Tuning Network Ground or Transmission Line Shield or Braid at Base of Antenna.

with other information, by commercial and military communications engineers to lay out the complex antenna fields used for successful and highly reliable point-to-point communication so vital to our nation today. If one is trying to radiate the maximum amount of energy obtainable from his transmitter in a given direction with a high degree reliability in mind he cannot afford to approach the problem haphazardly. The ham today, with the myriad of stations on every amateur band and a limit on his maximum power, must install his antenna and ground system with the same degree of concern if he is to be able to compete in the crowded ham bands.

Another interesting aspect regarding ground is the radiation resistance of the antenna. As can be seen by the graph of Fig. 4, the radiation resistance of a half-wave horizontal dipole can vary from approximately 58 ohms to about 98 ohms for heights of over ¼ wavelength above perfectly-conducting ground. If you want to use that 72 ohm coax for a transmission line and expect to read a 1:1 standing wave ratio on your bridge or reflected power meter you can use this graph to determine the height at which your antenna should be installed. Remember though, this graph is based upon the antenna being above perfectly-conducting ground. Do you know where your actual electrical ground is? If you don't and you want to use this graph to the best advantage you should establish your ground system effectively by installing one.

Ungrounded antennas such as doublets, zepps and directive arrays should be installed over as good a ground system as practicable. While these antennas are normally quite efficient, the losses present are usually the result of ground imperfections. The efficiency and radiation angles of ungrounded antennas are dependent upon the combination of direct waves leaving the antenna *and* the reflected waves from the ground. If the

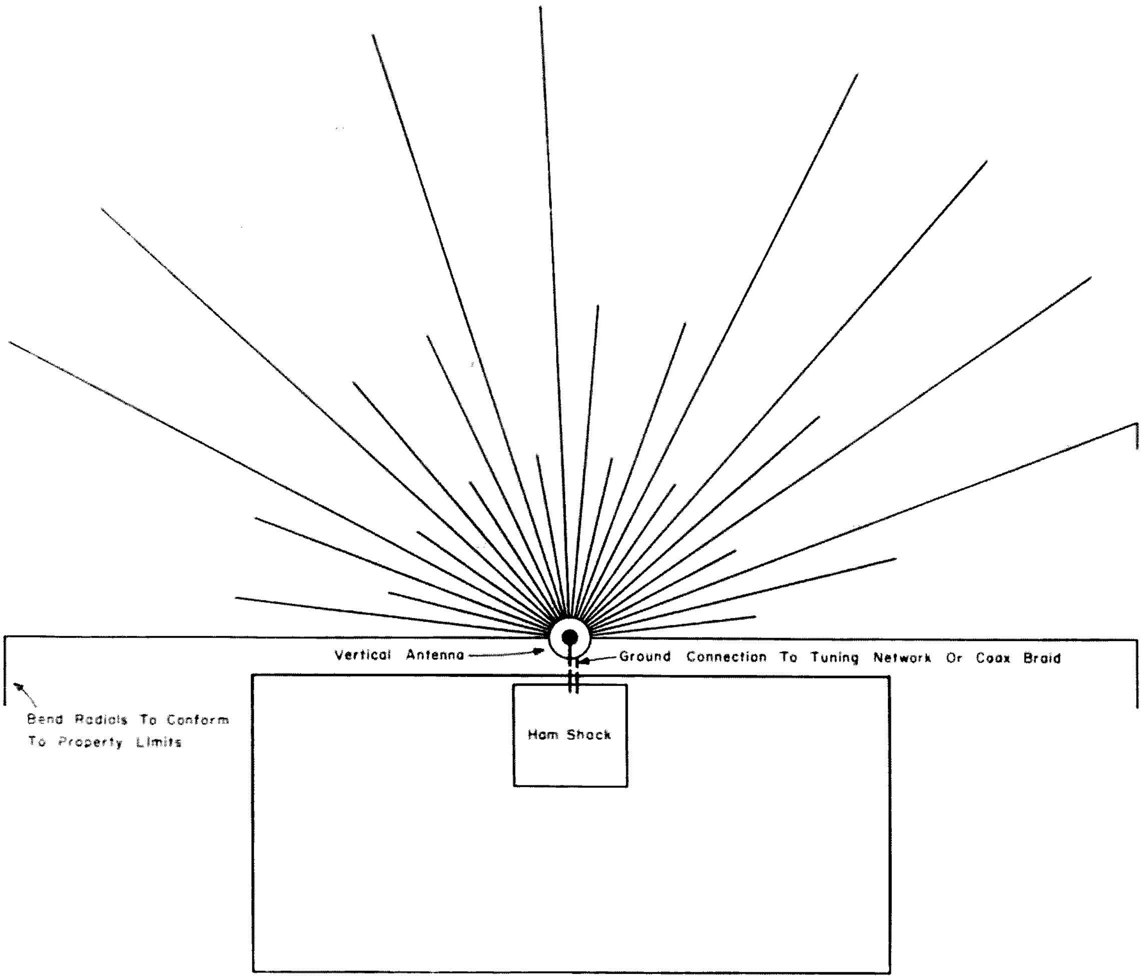


FIGURE 7

Typical Antenna Ground System Layout For Vertical Antenna Located Next to House.

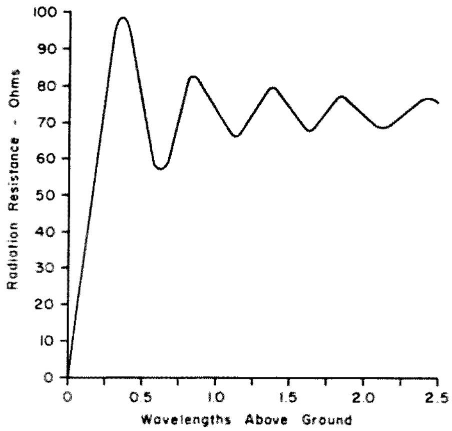
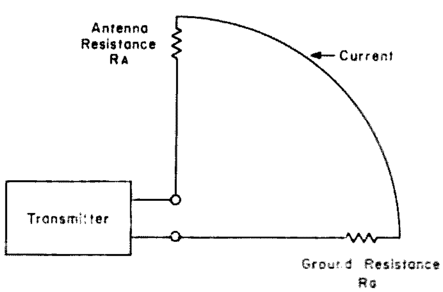


FIGURE 4

Variation in Radiation Resistance of Half-Wave Dipole Over Perfectly-Conducting Ground.

ground is not of good conductivity a considerable amount of energy will be absorbed due to the ground acting as a dielectric with considerable loss instead of as an efficient reflecting surface. For this reason the operation of ungrounded antennas over sea water is usually enhanced by the ocean's high conductivity. The reflecting surface of the earth or the "effective reflecting plane," as it is sometimes called, is usually several feet below the actual surface and may be quite a few feet if one is situated over peat or muskeg. In the case of a location over a filled-in area it is difficult to determine just where the actual ground is. Since ground conductivity measurements are not within the realm of average amateur capability the simplest thing to do is to assume that your ground conductivity is perhaps average and that you really do not know where your actual ground reference is. In this case the installation of a ground screen several inches below the surface of the ground and in the area beneath your proposed antenna installation will effectively establish your reflecting ground surface. The graphs and charts will become more meaningful since you now have a



Transmitter Output Is Dissipated Proportionately Between RA & Rg

FIGURE 5

Antenna System Resistance For Vertical and Horizontal Antennas Worked Against Ground.

starting point from which to work. The height of your antenna above ground will now be the actual distance that your antenna is above your installed ground screen. You can now predict, fairly well, what the characteristics of your antenna will be, that your vertical radiation angle will be approximately what the graph says it should be and that the efficiency of your antenna system will be about the best that you can possibly make it.

Horizontal and vertical antennas that are operated against a ground, that is, one side of the transmitter output connects to the antenna and the other side connects to ground, must have a good ground or suffer a considerable loss in efficiency. These antennas make use of the ground for the flow of rf energy back to the transmitter. This energy normally returns on the shield or braid of the coaxial transmission line if it is used. In the event that one uses the off-center fed Windom with a single wire feed system he must also provide a substantial ground system if the benefits of this type of antenna are to be realized. Here again the rf current makes its way back to the ground side of the transmitter output connection through whatever devious path is available. Obviously the ground connection, or path back to the transmitter, should be as low in resistance as possible for maximum efficiency. A typical antenna system operated against ground might be seen as in Fig. 5 as far as the dissipation of the transmitter output is concerned. It can be easily seen that the radiation resistance Ra of the antenna must be large in proportion to that of the ground system resistance Rg to avoid most of the power being dissipated in the ground system resistance. If Ra is equal to Rg then one-half of the rf energy being fed to the system is being lost in Rg. Not a very effective way of getting out, is it?

Lower frequency antennas are especially susceptible to losses due to the large currents which flow in the earth near the antenna. These losses can be practically eliminated with

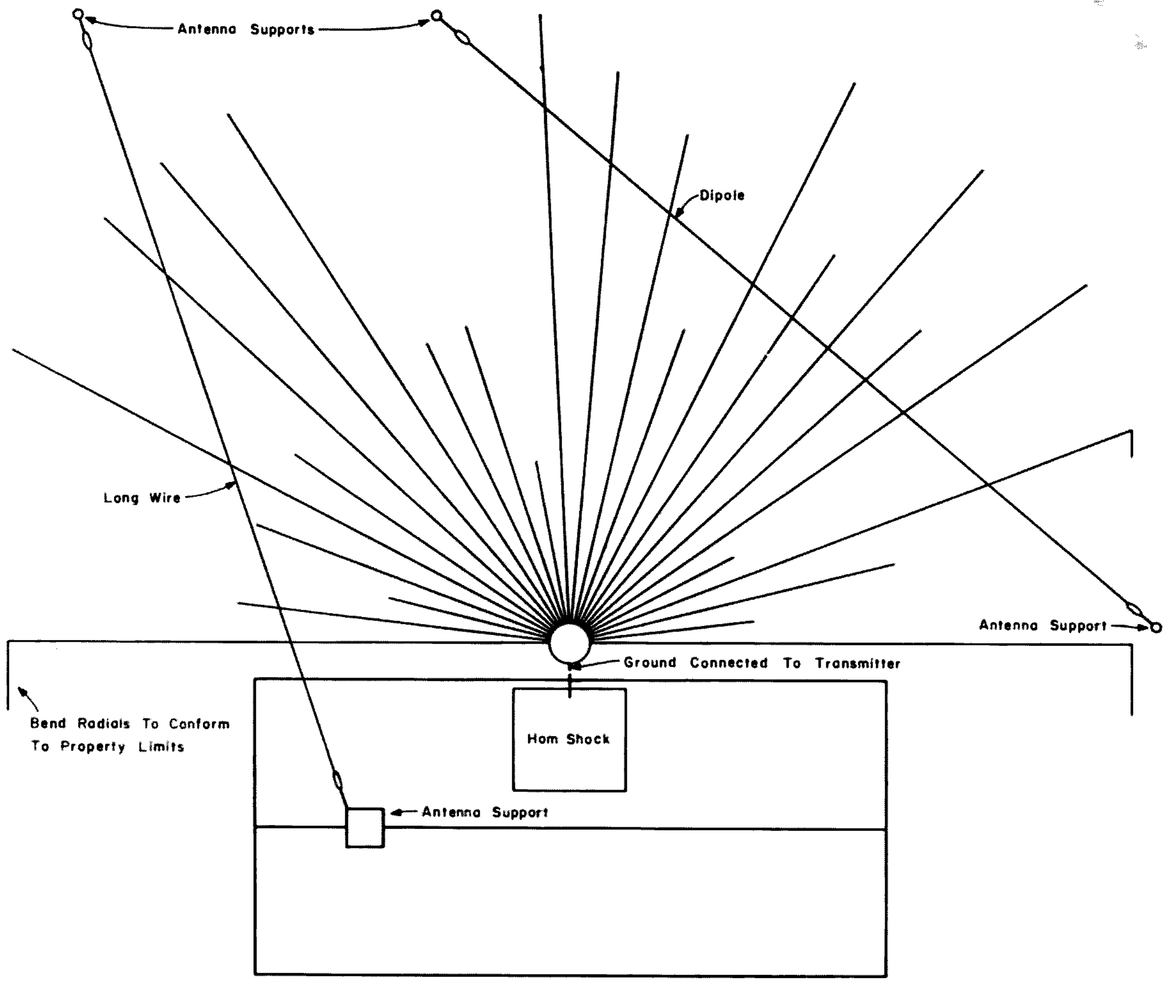


FIGURE 8
Typical Antenna Ground System Layout For Horizontal Antennas.

a good ground system providing an antenna efficiency above 90%. The radiation resistance of a vertical antenna shorter than ¼ wavelength is such that very high currents flow in the ground, more so than for a ¼ wavelength antenna, and for this reason the ground system is even more important. With a good ground system even ⅛ wavelength antennas can approach the efficiency of a ¼ wavelength antenna using the same ground system. It has been determined that the efficiency of a ¼ wavelength vertical antenna with as few as 15 radials may be on the order of only 50%. Decreasing the number of radials to 2 results in an efficiency of only 25%. Can you afford to throw away 75% of your transmitter output? Many hams are doing just that because of their neglect toward the antenna ground system. Let's hope that you are not one of them.

Once it has been decided that something should be done about improving or initially installing a ground system, the question arises as to just how far one should go. The best thing to do, as mentioned previously, is to assume that the ground in your area is not perfect and then try to install the best ground system that is economically feasible and physically practical. The ideal ground system, consisting of 10 wires each at least ½ wavelength long and extending radially from the base of the antenna, is not always practical for amateur installations. The author has found that the best rule of thumb to follow is to put down as much copper as is convenient and economical in the immediate area of your antenna. The lengths of the radials are usually limited by the size of the lot. Even if one has a small lot he should not be deterred since the gain in efficiency will be well worth while. Any size of copper wire larger than #16 will be quite satisfactory for the radials. Don't rely on water pipe grounds for your antenna ground system. In most cases water pipe grounds are not sufficiently extensive to do much good. Many areas are making use of plastic pipe which precludes the use of the water pipes in these areas. Poor electrical joints due to the use of pipe compound are another bugaboo experienced in making use of water pipe systems. Typical arrangements for antenna ground system installations are shown in Figs. 6, 7 and 8.

Cutting the radial wires to length and bonding all of the wires together at one central point is not extremely difficult but it can get somewhat tiring especially when one tries to tie 40 or 50 wires together in one place. There are any number of ways in which the central connection may be made. If the resultant is satisfactory both electrically and mechanically the method used can be considered to be as satisfactory as any other method. For those who wish to avoid the work in fabricating the antenna ground system, a complete radial system kit for the average amateur installation can be obtained from Ready-Radials listed in the pages of 73 Magazine. These kits provide all of the necessary components for the ground system. The radial wires are all connected to a hub ring to which a ground connection strap is attached. Wooden pegs are also provided to facilitate the anchoring of the radial wires to the soil or turf. Regardless of how you obtain your ground radial system the author recommends that the wires be buried except if the installation is to be a temporary one. Burying the wires a few inches below the surface of the ground will prevent the family from entangling themselves in the radial wires and will also prevent the wires from being chewed up by the lawn-mower. Burying the wires may be accomplished by slicing the ground with an edger or other suitable tool and then pushing the radial wires into the slit. Once the wires are buried you need not worry about them for a long time. Your ground system is in for good.

If you are not completely satisfied with the operation of your present antenna and suspect that you may be wasting much of your transmitter output you may find that the installation of a good ground system will produce results that you have never had before. Give your antenna at least an even chance of radiating the output of your transmitter and you will be better able to meet the competition on the ham bands.

. . . K4ZGM

Correction

Dear Wayne:

I just answered a reader who built the transistor power supply in the April, 1963 issue. He made substitutions for just about every component in it. His major problem was that it had approximately five volts output, which could not be varied. Fortunately he described things in great details. It took me awhile to realize that the rectifier diodes D1—D4 are all shown backwards in the schematic! The circuit is peculiar in that the polarity of the voltage at the output terminals is the same regardless of the polarity of the unregulated voltage applied to the input.

My turn for a red face! In checking back I found that I goofed in copying the finished schematic to be included with the manuscript. The schematic is otherwise correct. Either the diodes, or the two bridge output leads need be reversed to correct the difficulty.

C. E. Miller W1ISI

Inter-Element Conductivity

Beam type antennas usually incorporate telescoping element provisions to facilitate tuning for a desired frequency. In addition, adjustment preferences as to maximum front-to-back ratio and maximum gain are further expedited with adjustable element tubing.

Newly installed antennas, whether commercial or homebrew, require some alteration in order to obtain the maximum power transfer factor. Once the unit is properly adjusted it is assumed by the amateur, although incorrectly, that his radiating system will retain its initial inherent characteristics. Little thought has been given to the finite resistances developing between element joints due to the consequences of outdoor exposure. Aluminum, for example, develops a scale of oxidized material which has a lower conductivity factor than aluminum, thereby restricting the flow of voltage and altering electrical and impedance characteristics.

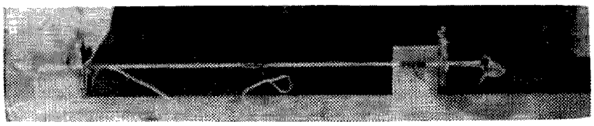
To provide unrestricted voltage flow, Penetrox A has been developed by the Burndy Corporation (Norwalk, Conn.) to insure continuity through mechanical joints where a low loss dialectic constant is requisite. Chemically, the material is a composition of petroleum and alum stearate base grease and zinc dust. The theory is that the grease component seals off the coupled units from the effects of the weather, whereas the zinc provides the medium for a low resistive path.

An engineer from Burndy indicated that the Penetrox material melts to fluid at 165c but "joints tested at 200c were excellent elec-Penetrox material melts at fluid at 165 C but "joints tested at 200 C were excellent electrically." He indicated further that "extensive and intensive testing has proven that Penetrox A does not lessen the insulating qualities of rubber . . ."

To use, lightly sandpaper the units to be joined with emery cloth and liberally apply Penetrox to both sections. A suitable clamp arrangement will insure a secure mechanical bond.

Additional trouble-free years of antenna use will result as the direct consequence of utilizing this material; however, its use is not entirely restricted to antenna design. Those amateurs using the electrical conduit as transmitter ground potential will also benefit from resistive free mechanical connections between the transmitter ground and reference ground via the many B-X and conduit joints.

. . . WB2CQM



Overall view of maser tube.

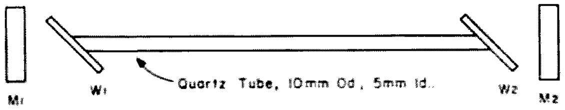
Richard Solomon W1KSZ
47 Withington St.
Dorchester, Mass.

The Beginning

A new dawn is breaking over that wonderful world called Amateur Radio. A whiff of that magical essence that inspired people as Hiram Percy Maxim, Sam Harris, and other such notable hams is wafting itself over the ham domain again.

This breeze carries the name; *optical maser*. This device, capable of carrying more information than now carried by all the services up to the highest television channel, is sweeping the commercial world like wildfire. In the past 2 years, more than 5 companies, entirely devoted to this branch of physics, have sprung up.

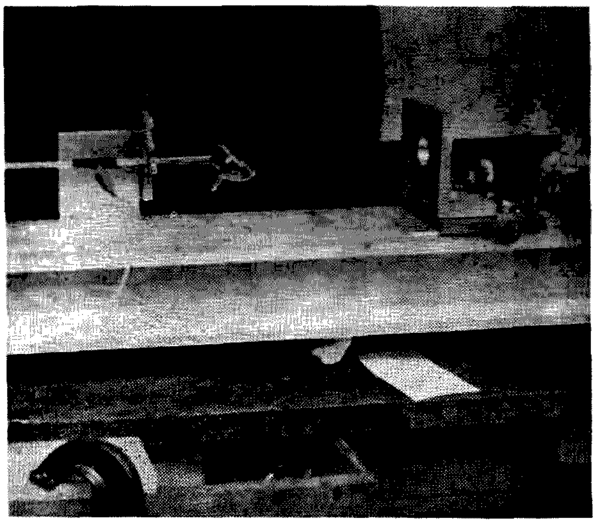
But first, a little historical background to this device. In the early 1950's, Dr. Charles H. Townes, then of Columbia University, along with his group formulated the idea of amplifying weak signals by use of stimulated emission of radiation, this led to the *maser*, which means, microwave amplification by stimulated emission of radiation. In 1953, Townes' group built the first workable microwave maser, using ammonia gas, but its frequency was fixed. In 1955, while in Paris, Dr. Townes got the idea of using a specially doped germanium as a maser, but it wasn't till 1956, that Bell Telephone Labs, and MIT's Lincoln Lab built the first solid-state maser. Then in 1958, in answer to Dr. Townes search for an infrared generator, Dr. Arthur Schawlow of Bell Labs suggested using two mirrors to reflect the light back and forth through the crystal, and the first optical maser, or laser, was born. The term laser stands for; light amplification by stimulated emission of radiation. But it wasn't until the summer of 1960, that Dr. Theodore Maiman, then at Hughes Aircraft Research Center, by using a piece of single crystal ruby rod got the first operational laser. This ruby laser was only a pulse unit. It took only 3 months for a group at Bell Telephone Labs, headed by Dr. Ali Javan, now at MIT, to produce the first operational CW gas laser. The gas laser therefore is our story.



$M_{1,2}$ — dielectrically coated mirrors
$W_{1,2}$ — end windows (optically flat and parallel)

The optical maser, hereafter referred to as the maser, is composed of a glass tube, preferably quartz or pyrex, about 10 millimeters (0.400") thick, and has two windows on either end. These are usually quartz, or some form of special glass made by Corning (7056, 7052). The windows are placed at a certain angle to the tube, called Brewster's angle. This has the effect of polarizing the beam passing through the windows. There are two mirrors at either end of the tube; these can be placed internally in the system, or usually, for experimenting, they are placed outside the end windows. These mirrors have the effect of the tank circuit in a transmitter: they determine the output frequency, and reject all other signals. The mirrors are coated with alternating layers of two chemical compounds, each layer about a quarter-wave thick. At 2.6 x 10^{14} cps a quarter wavelength can be mighty small (0.0000000000001 inch). The tube is then evacuated to a very high vacuum (10^{-8} Terr), and then filled with a mixture of helium and neon. The pressure and mixture are determined also by the output frequency, called the line at these levels. The tube is then carefully aligned and the mirrors aligned to almost perfect parallelism. An rf discharge is then coupled into the tube, and if everything is alright the tube should "mase".

Without going into Ph. D. type physics, the maser action occurs when the discharge in



Closeup of end of tube, showing tube, end window and mirror on mount. The variable coils in the front are used to match the rf to the tube.

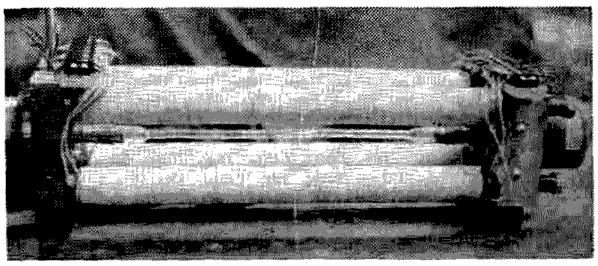
the tube causes the tube to show some energy gain in the form of light amplification from one end of the tube to the other. The mirrors then reflect this light back and forth, similar to positive feedback, until oscillation occurs. The maser signal then passes through the mirrors and out each end. The signal is now ready to be studied.

The output frequency of the maser, depending which mirrors are used, usually is one of 3 lines, or transitions, as they are sometimes called. They are; 1.153u, 3.39u, and the visible line, 0.6328u (u is microns, meaning 1u is 300 million mc). The stability of these units is dependent mostly on the geographical location. It varies from 1 part in 10^8 in noisy places to a present figure of 1 part in 10^{14}. Pretty good when you think that most vfo's are called "rock stable," if they are as good as 1 part in 10^6.

The "line width" as it is called, is similar to the "Q" of the final tank, in that it determines how much information can be carried by the single frequency, for example, say a Q of 10 on 50 mc. This means that the 3 db points are plus or minus 2.5 mc, or a 5 mc signal could be carried or used to modulate the transmitter final. The "Q" of the maser is about 3,000,000. This seems quite large, but with a center frequency of 264,000,000 mc, this is a bandwidth of 900 mc. Therefore on one maser signal you could carry all the information now transmitted, from the lowest loran signal through the highest TV channel, with plenty of room to spare. Quite a way to alleviate QRM.

So what, you say; big deal to modulate light, everyone knows how light scatters when it leaves the source. Think of the lens needed to concentrate the light, read on, me lads, all is not told yet. This light beam is *coherent* light This means that the light does not scatter, that it comes out in one parallel beam, that with a small cheap lens the divergence of the beam is *zero*. This means that the beam could travel the length and breadth of the universe and not enlarge its diameter more than a fraction of an inch.

The modulation of the maser is another thing to contend with. How many ways are there to modulate something? You can amplitude modulate, frequency modulate or phase modulate. Amplitude modulation is by far the easiest. The author plans to use a piece of KDP (potassium dihydrogen phosphate) crystal, obtained by devious methods well known to hams, mainly the long lost art of "knowing the right people in the right places." This KDP crystal exhibits the phenomena of being able to transmit or block the passage of light by means of applying a voltage across the crystal. A simple 125 watt modulator, using a 30K 200 watt swamping load suffices to deliver the necessary audio power to modulate the maser beam. For reception of the maser signal, a photo-detector of some sort is needed. Anything from an elaborate gold-doped germanium crystal to some simple selenium photo-cell (such as the "solar battery") can be used. An audio amplifier completes the communications system.



Closeup of Highly stable maser. Four coils are wound around invar rods. The coils are for magneto striction tuning of maser.

DX on this band consists of how far away can you go, and still align the system properly. A mirror such as used in solar furnaces could be used to collect the signal, with the detector at the focal point. This would loosen the restrictions on close tolerence alignment of transmitter and receiver systems. Pulse maser signals, from a large rod made of ruby, have been used at MIT and Raytheon to bounce maser signals off the moon.

More sophisticated methods of modulation can be used to carry information on the maser beam, but require more delicate alignment

and high level electronic circuitry. A system of frequency modulation is presently being tested at MIT, and might be operational very soon. This is the field hams can have fun in.

To make one of these units just now, the cost would be prohibitive, but in a few years, the prices will drop sharply. For example, last year complete optical gas maser systems were selling for over $10,000; by June of this year, you could buy complete systems for under $1,000. This trend will continue, until the time when the ham will be able to get one of his very own, to play with and experiment with. Hams who know people in the optical world have a much better chance of being able to make one of these than anyone else. All you need is to know the right people.

. . .W1KSZ

How Good is your Receiver?

Joseph Marshall WA4EPY
Ozone, Tenn.

Receiver sensitivity is ordinarily measured in a shielded room with a signal generator and a dummy antenna. While this gives a useful absolute value it is not necessarily a measure of the practical sensitivity that will be achieved by the receiver in actual use in any given type of service.

We all know that the sensitivity of a receiver is limited by the total noise the signal faces at the input of the receiving system. This noise has three components: the noise generated by the receiver itself, the noise generated in the antenna by the motion of electrons within it, and the noise picked up by the antenna from space. The shielded-room" sensitivity includes only the noise generated in the receiver and antenna.

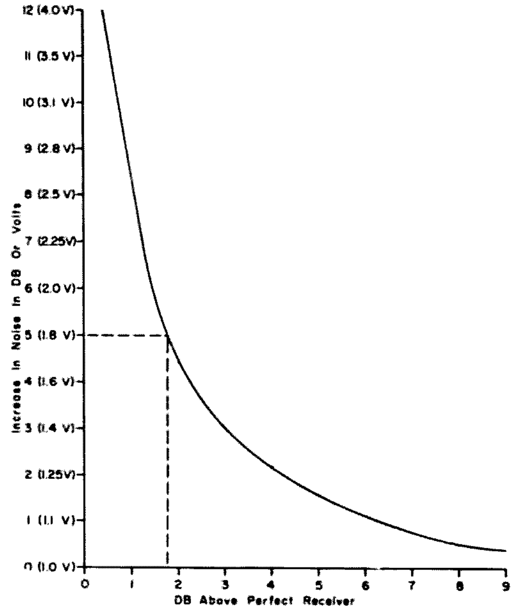
When a receiver is connected to an antenna in space, the antenna will pick up external noises and these will increase the total noise the signal faces. Hence the actual sensitivity of a receiver will be considerably poorer when it is in actual use than it is in the shielded room.

The noise picked up by the antenna will vary with 1) the frequency operation because the noise generated in space also varies with frequency; 2) the directivity of the antenna because the narrower the acceptance angle of the antenna the smaller the proportion of the total noise in space it will pick up; and 3) finally, with the receiving location because noise, especially man-made noise, will vary from location to location.

Because of these variables it would be impossible for a receiver manufacturer to attempt to state the actual practical sensitivity of his receivers. However, you can quite easily determine how good your receiver is in your own location, and in the frequency range of your operations, by making some simple measurements and using the charts.

The equipment needed is quite simple: 1) a carbon resistor whose resistance is the same value as the input resistance of your receiver—50,72 or 300 ohms as the case may be; and 2) a vtvm or ac voltmeter capable of reading an ac voltage of about 1 volt. The procedure is as follows:

1) Disconnect the antenna from the receiver and connect in its place the equivalent resistor. Use the shortest possible leads on the resistor. If the receiver has a coax input, solder one end of resistor to the center of a coax



plug and the other end to the shield.

2) Connect the voltmeter to the headphone jack of the receiver. If it has no headphone output, connect it across the highest tap on the output transformer, or across the speaker leads. A more sensitive meter is desirable if the measurement has to be made across a 4 or 8 ohm loudspeaker since the voltage will be lower.

3) Turn the avc off, be sure the noise limiter is off, and turn the rf gain control all the way up. Adjust the audio volume control so that the noise voltage reads 1 volt or Odb, if the meter has a db scale. Because of the random character of the noise and shot transients, the meter needle will swing erratically about ½ to 1 db. Adjust the control so that either the maximum or minimum swing hits the 1 volt or 0 db mark.

4) Do not disturb the controls. Remove the resistor and connect the antenna to the receiver. Assuming your receiver has a reasonable noise figure, the meter will show some increase in the noise voltage. Carefully read the increase either in volts or decibels. If you adjusted the controls in the previous step for a minimum or maximum swing, be sure to read the meter in this step the same way.

5) On the graph of Fig. 1, along the vertical calibrations on the left, find the point that corresponds to the meter reading when the antenna was connected. Move horizontally along this line to the point where it crosses the curve, then vertically downward to the calibrations on the bottom of the graph. This will give you the difference in db in total noise, and therefore in sensitivity, between your receiver and an ideal or perfect receiver using the same antenna, at the same frequency and the same location. In other words, it gives you the improvement that you would achieve if you could get a perfect receiver to replace the one you now have.

Example: Let us suppose that when you connected the antenna in place of the resistor the meter reading rose from its original Odb or 1v point to 5db or 1.8 volts. Moving along the line that is occupied by 5 db or 1.8v to the curve and then down to the baseline we see that we get a reading of approximately 1.75db. This indicates that at that frequency and with the noise that the antenna picked up at that time, your receiver is only 1.75db poorer than a perfect receiver would be. Since 1.75db represents a ratio of about 1.222, this means that you would obtain an improvement of only 22% in sensitivity if you replaced your receiver with a perfect receiver.

It is a good idea to repeat these measurements at different frequencies, at different times of day, and with the antenna pointed in different directions if it is rotatable. Be sure to find a frequency within any given band that has no signal. This will be rather difficult below 20mc and above 3mc in the daytime. You may have to try the measurement late at night or in the wee hours. You will find some variation in the noise picked up by the antenna from day to day and depending on the direction your beam is pointed to. If the beam is pointed straight at the Milky Way or the sun, for example, the external noise will be very much higher than it is when the antenna is pointed at "quiet" portions of the sky; and, of course, your receiver would look much better than it actually is in the average direction and average time of day.

You will find that you get a pretty big variation in the reading as you move upward in frequency. Your receiver will be much closer to the perfect receiver below 20mc than above. In fact, below 20mc, most receivers, even inexpensive ones, will come pretty close to the perfect receiver. But as you go upward in frequency, and especially when you get above 30mc, you will find that your receiver is poorer when compared with the perfect receiver.

However, this does not mean that your receiver is less sensitive at the higher frequencies. On the contrary, it will probably be more sensitive. The useable sensitivity of a *perfect* receiver improves as the frequency increases. This is true because the noise picked up by the antenna decreases very sharply as the frequency is increased. The perfect receiver would be most sensitive—that is, capable of reading the

weakest signal—above about 300mc. In this part of the spectrum the external noise is a small fraction of the noise generated by the antenna itself, and therefore the sensitivity approaches very closely the shielded room sensitivity.

On the other hand, below 10mc, the external noises are several times stronger than the antenna noise, and indeed several times stronger than the noise of most receivers. Hence, even if we could eliminate the receiver noise completely, there would still be enough noise to limit sensitivity to a relatively low value. The noise below 10mc will be so high most of the time that even a perfect receiver would require a signal of 1 microvolt or more for a 10db signal to noise ratio. On the other hand, above 200 or 300mc, the external noise is so low that if we had no receiver noise at all, we could read a signal as low as .1 microvolt. Unfortunately, it is much harder to approach the ideal receiver at the very high frequencies.

Generally speaking we can say that when a receiver used for voice or code communication—where the ear is involved as the sensing element—is 1db above a perfect receiver, there is no point whatever trying to improve it. First, the difference could not be heard (though it could be measured), and secondly, it would take the impossible jump to a perfect receiver to make any significant difference at all. For most purposes a receiver 3db poorer than the perfect receiver will represent a practical optimum. Especially above 100mc the cost of approaching the ideal receiver more closely becomes disproportionate as compared with the actual improvement in useful sensitivity.

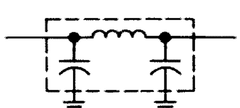
Effective Filtering

or shut that thing off!

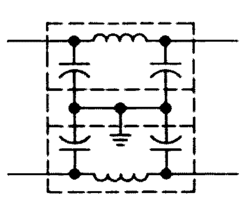
Jock Struthers W2OZY
Bracken Rd.
Morrisonville, N. Y.

When the vacuum cleaner or the kitchen mixer is turned on, do you increase your bowling ball appearance? Does your Jr ops electric train develop a straight out feeling? If so, perhaps a few oft-missed points in the filter department might be good to review.

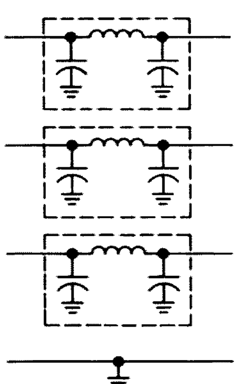
Interference types include atmospheric, static, precipitation static, background noise, cosmic noise and man-made noise. Any discussion of man's efforts to generate noise must include rotating electrical machinery (especially commutating types), ignition systems, breaker points (relays, distributors, etc.), pulse equipment, equipment intermodulation & cross modulation, diathermy, induction heating, welding, hum at power and audio frequencies and gas vapor ionization such as mercury vapor and thyratron tubes, fluorescent & neon lamps. How any of these man-made troubles get into our receivers depends on the degree and type of coupling which is defined as the means of transfer from one circuit to another. Coupling types are: Capacitive or electrostatic, inductive or electromagnetic, direct radiation and conduction.



Unbalanced Single Circuit



Balanced 2 Circuit



Poly-Phase Filter

The simplest form of bypass for radio frequency energy is the condenser, and in our selection thereof there are four cardinal rules to be followed:

1. Never use an electrolytic condenser as a radio interference filter
2. Always use non-inductive type condensers
3. Use hermetically sealed condensers with one side grounded for values over .1mfd
4. For values under .1mfd, molded paper, ceramics or mica are suitable

Whenever a condenser will suppress the noise to the desired degree, it is unnecessary to use any of the more complicated filter systems such as "L", PI, or "T" types. Filter selection depends on the type of equipment to be suppressed and the amount of suppression desired. Factors important in filter selection are: rating, attenuation, voltage drops, maximum capacitance, insulation resistance and maximum test voltage. Uuless otherwise stated by the filter manufacturer, a filter safe test voltage should be at least twice rated voltage.

It is more often desirable to have the filter built in at the source of the noise since capacitive or inductive couplings may take place in a power or coaxial transmission line. Doing so will eliminate the need for much complex shielding and grounding to eliminate low level mutual coupling. Filter specifications common to but varying in importance in all filters are:

1. Voltage rating of the line in which the filter is to be inserted.
3. The maximum current which will pass thru the filter.
3. The duty cycle of the filter. This applies to decreased load current of intermittent operations.
4. The power frequency.
5. The tolerable ir drop at the power frequency.
6. Maximum operating temperature of the filter.
7. Band of frequencies required to be attenuated.
8. The amount of attenuation required.
9. Circuit requirements of insulation resistance.

Here are three types of power line filters:

Common Filter installation faults most often include:

1. Too long a ground return: This return might resonate at a frequency thus generating large radio frequency to ground and thus radiate.
2. Poor filter case grounding: Poorly cleaned ground surfaces. Since low impedance to ground is necessary poor case ground connection looses the effect of the filter capacitor.
3. Too long primary leads: As with #1 above will radiate if resonant at a radio frequency. Also separation of input and output leads is mandatory since filtering effect would be lost by "bundling" them.
4. Use proper size terminal connector to aid current flow.

It cannot be over-emphasized that a poor ground connection is the most common fault in many types of electrical and electronic filter installations. Receivers, transmitters, motors, generators, alternators, relays, switches, neon and fluorescent lamps are all potential sources of communications interference.

Now that I have scratched the surface, perhaps you will be able to make some positive progress in the elimination of man-made noise in your QTH. At the very least, the preservation of what remains of your wavy brown locks has been accomplished.

. . . W2OZY

A. E. Lux
133 Las Flores
Goodyear, Ariz.

A Two Element Phased Array

Introduction

The art of feeding antennas with multiple feed lines appears to be reserved for the commercials or the engineering text books. Too many times one hears an expression on the air indicating that a beam is a Yagi. While the reverse is true it certainly is not true that parasitic beams are the only kind, nor necessarily the best kind for a particular application.

Let's start by giving a few quotes from Kraus' book on antennas. If you have it refer to chapter 11. We will not bore you with the math but if you are interested get the book. Perhaps your library has a copy.

Section 4 of chapter 11 deals with two driven elements with equal currents of any phase relation. Referring to a 1/10 wave spaced antenna, Kraus indicates that the antenna gain is maximum at this spacing and nearly constant from ⅛ to ¼. However at and below 1/10 wave length spacing excess loss resistances occur, and larger loss resistances occur at considerably larger spacings. "A spacing of ⅛ wave length has the advantage that physical size of the antenna is less. However resonance will be sharper than for wider spacing."

Now what can we do with this line of reasoning in so far as the low frequency amateur bands are concerned? Obviously we want the maximum gain and front to back ratio available, but not the losses or sharp resonance condition referred to. This can be done to good advantage by the use of folded dipoles spaced to lower the "Q." It is of course necessary to match the impedances.

One other point before leaving Mr. Kraus—
No rotator is required and wind loading is minimized.
Third harmonic (15M) operation is feasible, but with a broader pattern.
Less height seems to be required for reasonable results when both elements are driven.
Horizontal pattern—broad, cardioid shaped.
Angle of radiation—low.

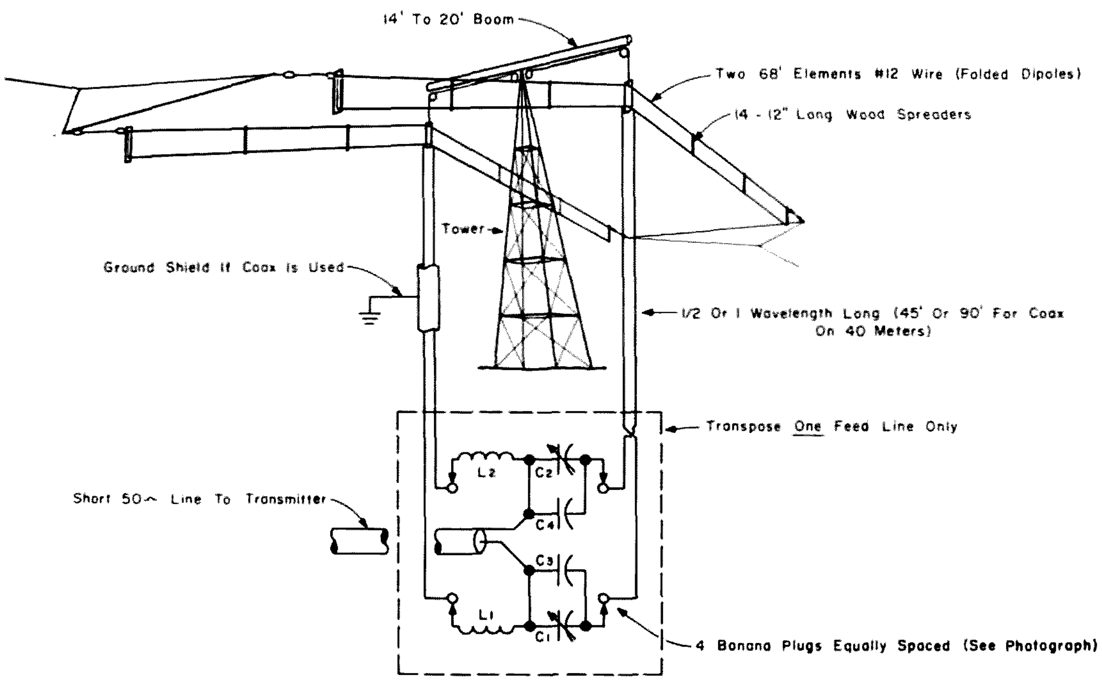


FIGURE 1

L_1-L_2—9T 1¼ dia.
C_1-C_2—100 mmf variable
C_3-C_4—.0003
Freq.—40M, resonate C_1 C_3 L_1

Approximate values are for 40M and 150° phasing. Feeders are small coax with shields tied together to form twin lead—or 150 ohm twin lead.

although dealing with phased vertical antennas he indicates that at ¼ wave spacing maximum front to back ratio occurs if the elements are connected 90° out of phase. At ⅛ wave spacing it is maximum at 135° and if we project these we find that at 1/10 wave spacing we should use 150° phasing.

The Antenna

This antenna has been in use at W7RTP for about six years. In its original form it was described in QST (December 1956). It has given an excellent account of itself on 40 meters for those who erected it. However, experience is a great teacher and the following version has evolved.

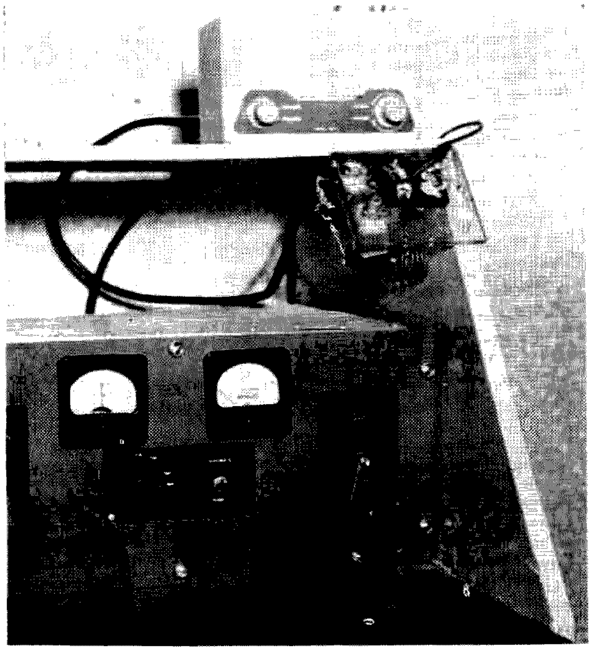
The characteristics of the beam on 40 meters are as follows:

SWR—less than 2-1 for a band width of 255 kc.

Front to back ratio is about 20 db.

Power gain is probably about 5 or 6 db.

Input impedance—50 ohms (approximately).



Right center—the phase shift network. Note the removable plug and the components mounted on the back of the board. The linear is a pair of 4X250 B's in grounded grid.

Balanced feed is used to low Q elements.

As shown in Fig. 1 the antenna consists of two open wire folded dipoles ½ wave long, spaced about ⅛ wave apart. They are in the form of inverted "Vs" for mechanical convenience. Of course they could have been mounted in any manner suitable to the location.

The tower supports the boom which should be ⅛ wave long (or more) and has an aircraft pulley mounted on each end and two near the center as shown in Fig. 2. A ⅛" flexible aircraft cable supports the elements and after passing through the pulleys is secured at the bottom of the tower. The length of each cable should be twice the height of the tower. This arrangement makes it easy to raise or lower either or both of the elements in a matter of seconds. Caution–don't use a smaller cable, it may jump off the pulley and jam.

The ends of the elements are supported by a yoke as shown in Fig. 1 and photo. There does not appear to be much sacrificed by reducing the end spacing slightly so our yoke is a 10 ft. long piece of 1" aluminum tubing located about 10 ft. beyond the element ends. Each element should have at least two insulators at each end as shown.

The two center support insulators are shown in Fig. 2. They are made from a ¾" wooden dowel or old broom handle. They should be soaked in linseed oil or boiled in paraffin. No paint! Same for the twelve ½" dowel spreaders. In as much as there is no difference in potential at these locations wood provides good results and is light in weight.

The elements themselves can be made from #12 or #14 antenna wire and are ½ wave long; in our case 68' is required for a center frequency of 7225. The formula $L' = \frac{490}{F\,mc}$ seems to apply. Note that this is the formula for a reflector in a parasitic beam. Be sure the elements are both exactly the same length.

The feeders preferably should be made from small dia 50 or 75 ohm coax. (RG58 or 59.) (Use 75 ohm if spacing is greater than 18 ft.) Four lengths will be required and this may cost you more than you care to spend. If so, *you can use 150 ohm T.V. twin lead with reasonably good results.* (Available from large mail order houses.) But don't expect as much front to back ratio or noise reduction. Also allow for a velocity factor of about 72 (instead of 65 for coax) when calculating the feeder length for a half wave. Actually, what is needed is 100 ohm shielded twin lead. In as much as the power is divided between the 4 lines there are few losses and plenty of power handling ability.

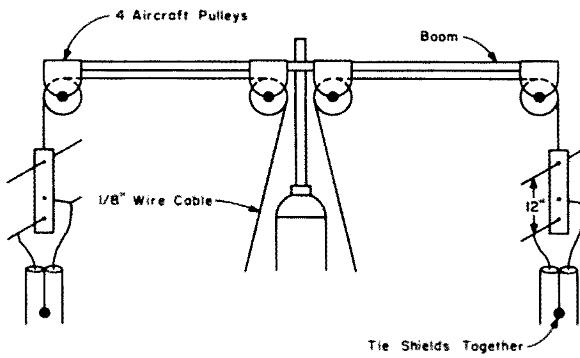


FIGURE 2

If you elect to use coax, take a pair of them, either ½ or 1 wave long, and tie the shields together at both ends. Ground the bottom end. Do the same for the other pair. Connect the center conductors to the antenna as shown in Fig. 2. The bottom end of the center conductors are connected to the phase shifting network plug. A short length of flexible twin lead should be used to facilitate changing the plug. Be sure to transpose one feeder as indicated and keep them both exactly the same length.

The directivity is changed in the phasing network by adding or subtracting about 30° from the 180° given by the transposition of the feeders. (See photo) Obviously if a bidirectional pattern (like the old 8gk) is desired,

2 element 40 meter wire beam shown with ground plane. Note the long spring at right to compensate for tree movement in wind. The ground plane has been replaced with a two element rotary.

the network can be omitted for 180° phasing. See Fig. 1. The two series circuits (C_1 C_3 L_1 and C_2 C_4 L_2) are resonated by rotating C_1 and C_2 while watching for a dip in the reflected power as shown by an SWR meter. Every ham should have one!

The value of C_3 and C_4 will depend somewhat on the feeders. Approximate values can be found by temporarily connecting the open ends of series circuit together to form a parallel circuit and grid dipping them to frequency. The main thing is to keep each side equal. The values shown will result in a phase difference between elements of about 150° which is about optimum. Good quality receiving components are sufficient even with a kw because of the low impedances.

The two series circuits are located on a small circuit board and connected to 4 banana jacks that are symmetrically placed. Four banana plugs with similar spacing are placed on another small block and the feeders attached as indicated. Reversal of the plug reverses the beam. W3CTN does this with a 4 pole relay remotely located. Perhaps this could be used to eliminate the four coax but remember you have to get at the phasing network to adjust it. Once set it needs no further attention.

This method of phase shifting has been found to be more effective than using different lengths of feed line.

In discussing tune up procedure it should be mentioned that to check the resonate fre-

quency of the elements an antenna impedance bridge or grid dip osc. is connected to the bottom of one feeder. Be sure to short the unused feeder with a small resistor of 100 ohms (equal to the line impedance). Otherwise there will be considerable error introduced. Then repeat for the other feeder.

It may be advisable to use this procedure to correct the length of one or both elements especially if surrounding objects are in the field, as in the case of a low antenna. Actually, there is nothing very critical and most anything close will do a fair job but the extra effort will be rewarding.

Now a word about harmonic operation. It will not work on the even harmonics, only the odd. Therefore it does a fair job on 15 if cut for 40. Due to the increased spacing ($\frac{3}{8}\lambda$) on 15 however, the impedance will be off somewhat unless we insert a 15 M parasitic reflector midway between the two 40 meter elements. This can be attached directly to the boom in typical "plumbers delight" construction.

While this antenna has only been used on 40-15 there is every reason to believe that it should be excellent on any band. A set of four traps would make an interesting 75-40 project!

The antenna has worked its share of DX but the big advantage is in its reduction of noise, QRM, and ease of construction. The wire elements will perform just as well as tubing unless you insist on rotation.

It should not be confused with the 8JK or ZL special. There are numerous variations possible, i.e. the use of twin lead for the elements, $\frac{1}{4}$ wave spacing with 300Ω twin lead feed, etc., but the best results were obtained with the arrangement presented and a good impedance match is given to the transmitter without a coupler.

. . . W7RTP

Europe on $2000 a Day

W2NSD/1

October 6th came around, ready or not, Virginia had the November issue on the presses and I had a folder of letters and cables from hotels and hams assuring me that everything was go. My folks, who had been talked into volunteering as baby sitters for the next three weeks, picked up our six months old daughter Tully. I breathed a sigh of relief, thinking of the suitcases of clothes and diapers this would save Virginia carrying through Europe.

Though the drive to New York was as long and tiresome as ever, we arrived early, armed with travel brochures, name badges for everyone, a big carton of tickets, cameras, suitcases, flight bags, and confidence that everything was all set. What dreamers!

The BOAC jet trip to London was smooth and they did turn out the lights for a few minutes between dinner and breakfast so we could put our full attention on just how uncomfortable seats with restricted leg room and people packed elbow to elbow can be.

Suddenly we were in London and I was staggering out of the plane, festooned with carry-on luggage, an epic in wrinkles, my bloodshot eyes squinting our from behind the

sandpaper stubble of four-AM shadow. Somehow Sylvia Margolis, 73 authoress and XYL-G3NMR, recognized me and waved. Her first cheery words were, "Well, I see you made it alright, but where are your busses?" I rushed to a phone and called the hotel. "We thought you would do better to take the regular airport busses into town and then all take taxis to the hotel." I looked helplessly at their letter promising busses hanging limply in my hand. hanging limply in my hand promising busses.

Fortunately the bus company was accomodating and put on a couple extra busses, delivering us right to our hotel.

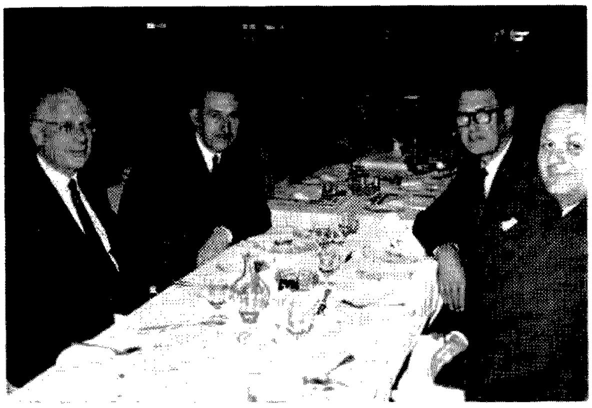
London is an excellent first stop on a tour of Europe because it introduces a newcomer to the European hotel system without making it even worse by adding a language barrier. Their hotels are different than ours, very different. Those that had read the recommended text, "Europe on $5 a Day," had little problem. They already knew what to expect . . . the water closets with paper that you bring home to prove you aren't lying about the choice between waxed paper or sand paper . . . the bath tubs that require an athlete to master . . . the "raw" bacon for breakfast . . . the slightly colored hot water they bring when you ask for tea . . . and a host of other litter surprises.

We were very fortunate to have only two grumblers on our tour. Not bad out of a total of 73, eh? I was proud of our group. With but the twe exceptions they were game for anything and as nice a bunch of people as you could ask to travel with. Hams are, with but few exceptions, way above the average in niceness.

The number one grumbler was Hank. He spent a good deal of the trip plastered, staggering from one person to another complaining about anything available. He kept bragging about being a world traveler and we eventually found out what it was all about. He had been in the Navy and visited a number of ports in the old Navy fashion. He was still at it, getting drunk in every port and bragging loudly about his old conquests, much to his poor wife's distress. He just never grew up.

While most of the group set about seeing the sights, Virginia set about finding an Italian Greyhound. She was determined to bring back a souvenir which we wouldn't forget. For two days she fed thrupences into the hotel phone all day long. Then my worst fears were realized, she found one. We picked it up Wednesday noon. Have you ever seen an Italian Greyhound?

This unbelievable slip of cuteness stands almost 12" high and looks like a miniature



G2AHL, G2MI, G3IIR, & G3BVG of RSGB.

greyhound. It bounces all over the place and collapses in a quivering jelly of ecstasy when petted. Although almost unknown in the U. S., there are a few of these being bred in Europe.

The hamfest came off as planned with almost a hundred U. S. and English hams and wives jammed into a restaurant for a typical fish and chips dinner, wine, speeches and a constant popping of flashbulbs as everyone took pictures of everyone else. Quite a few G's invited out to their homes for dinners and we all enjoyed this immensely. Sylvia, not content with setting up the hamfest, also had groups out to visit her and OM Morris G3NMR in the evenings.

Edgar Wagner G3BID was kind enough to treat Virginia and me to a magnificent dinner, complete with rare vintage wines, practically an obsession with Edgar. We shall never forget that dinner.

A luncheon with the top brass of RSGB convinced me that the British amateurs are in good hands. I was very pleasantly surprised at how clearly they understand what is happening over here at present. The RSGB offices are a lot like ours, with a small group of hard workers doing the work of three times their number.

The four days in London were up, seemingly in a few hours, and we bid goodbye to our friendly hotelkeeper as we left in two big BOAC busses. There was a quick flurry at the airport as I discovered that it was impossible to let everyone hold their own tickets. Some had them packed in their suitcases, some fellows handed in theirs, but not their wives, and one person suddenly announced that she had never gotten a ticket back in New York. This was all complicated by everyone wandering all over the huge terminal and us having to hunt high and low every time a ticket was wissing on the list. We held up the plane about fifteen minutes, but we all finally made it aboard.

During the hour jet flight to Paris (BEA

Caravelle) we got out our phrase books and prepared. As we stumbled off the plane we were met by a group of French amateurs, led by Pierre F2BO. We were given an indoctrination talk on Paris by Peter and then led through customs and aboard the two busses we had chartered. Our group, being a little large for one hotel, was split up with the bulk of us in one and most of the rest in another. Peter was everywhere, answering all questions.

In London most of the group visited the famous landmarks, Buckingham Palace, Westminister Abbey, etc. In Paris they again headed for the famous landmarks: the Lido, the Follies, etc. London's Underground had prepared everyone for the Paris Metro and most of the group soon was able to get anywhere in the city by subway quite readily. I spent most of my time going from airline office to airline office getting the tickets straightened out.

F9VR W2NSD/1 F8TH

Everywhere we went we ran across hams from the group . . . shopping in the department stores, on the Metro, at the Flea Market (where we bought eight fantastic tapestries and a suitcase to carry them in), in restaurants, and on the Champs. Pierre arranged a small hamfest for us and we all enjoyed talking with the F's. Some of us wrangled tours of the city and dinners and learned a lot more about Parisian life. I had a delightful dinner with M. Robert Brochut F9VR, the President of the R.E.F.

Pierre was everywhere. He drove several of the group out to Versailles, he drive or escorted many others to

Pierre was everywhere. He had been able to get a few days off from the army and turned them over to our group completely. He drove people around, took them sightseeing, helped

(Turn to page 70)

(Europe from page 67)

them find special things they wanted, etc. When we were leaving Paris for Geneva and were split into two groups because the Caravelles were a bit small to hold our entire group plus other passengers, Pierre escorted one group and his mother the other. I was so impressed by Pierre that we are going to import him to New Hampshire to work with us at 73. How's that for a souvenire? Not only will Pierre be helpful in running 73, but he will be marvelous as a tour director for future tours with his familiarity with just about all of Europe, plus his command of English and French.

We ran into our first serious hotel difficulties in Geneva. That really had me sweating for a while. We'll go on from here next month.

The weather was beautiful, sunny and warm, except for our first day in London when it drizzled off and on. We never needed an overcoat for the entire trip, save possibly for the nights in Berlin.

We were very fortunate on baggage. When you travel in a group it is possible to have them weigh all of the baggage in a lump and avoid the penalty for overweight. We were permitted 44 pounds. Virginia and I started out with 80 pounds and added suitcase after suitcase as the souvenirs added up until we ended up with about 200 pounds. No extra charge. We came back with 350 pounds last year.

The $2000 a day? That's about what it costs to keep 73 people going on an all-expenses (except lunch and dinners) tour of Europe. Hoot mon!

(W2NSD from page 16)

Working for 73

This summer we had six fellows come in to work for 73 during their vacations. Most of them had never been away from home before and this was quite an experience for them. We had lots of work for them too. In addition to little jobs like setting the table, washing dishes (a new experience to a few), cleaning house, feeding the horses, ducks, geese, goat, and other pets, there were 73-type things like collating pages of our bulletins on ham television, the 73 newsletter, and our new 6UP VHF magazine. Then they had to fold the magazines, staple them, address and mail them.

They learned all about working fourteen hours a day seven days a week. They learned all the inside information on ham manufacturing, ham publishing and even how our hobby is being run. Few amateurs know what is really going on, there are just too many things that can't possibly be published.

Just as the summer started we managed to acquire a little house way up on the highest mountain in southern New Hampshire. Our summer team painted the house, cleared all the trees and set up a truly magnificent bunch of towers and beams. The finished product will consist of a three element full size twenty meter beam up 60′ on a tower, a 16 element colinear up 60′ for six meters on another tower, a 288 element two meter beam up 120′ on another tower, a 32 element 220 mc beam up 100′ on another tower and a 192 element beam up 110′ on a fifth tower. Eventually we will probably have a tribander and a quad on two more towers. The rigs didn't go quite so well due to all the other work . . . but we did manage to keep a Clegg Thor on the air just about every night from up there plus all through most six meter openings. The lower frequencies got plenty of workout with all those hams on hand too. The fellows worked late into the night filling out QSL's.

Each of the six fellows had his own distinct personality. Some were fine, some difficult. One chap didn't last very long . . . within a few days he had everyone furious with him and we had to send him packing along. He had something thoughtless and sarcastic to say about everything that happened. He knew all the answers, acted like a kid and hot rodded around. Work? Forget it.

Then there was Jerry. Jerry was from a little town in Iowa and as square as they come. His eyes were wide open with amazement at everything. He was an epic in carelessness. He managed to step into the tower hole filled with wet cement, a two foot square hole in the middle of four acres. When he painted it was everyone for himself . . . paint sprayed everywhere. Our goat turned blue during the blue painting, white during the trim work and black while the shutters were being painted. Jerry was a surrealistic masterpiece when he took off his shirt. He tripped over anything, spilled any food you passed him, walked in mud or anything left behind by our pet department and tracked it unknowingly through the house. ATV Bulletin subscribers may wonder at the strange page arrangements we sent out in July. We found out that this was not quite up Jerry's alley. Jerry would hold a soda in one hand and tip it over on someone next to him trying to eat a cracker in the same hand. We got so we didn't notice after a while. Then there was the dinner when we served

his plate in the kitchen, chicken cacciatora. Jerry got it to the table, but then flipped the whole works onto the floor as he put down the plate.

But Jerry was really all right. He did manage to get most of the mountain house painted, ough it took him all summer to do a weeks k. The real trouble was with Goat Boy. We d him GB.

3 earned his nick-name because of his hant for trying to outbutt our goat . . . he sually won too. Both were exiled to the mountain house soon after their arrival as a protective measure for the rest of the crew. The goat, taught to butt by GB, was a menace to life and limb. GB, whose only accomplishment was the development of a relationship with the goat, depressed us and it was much better for morale to have him out of sight. We tried him on simple things like washing dishes . . . and he did a good job, but we all felt a little guilty as we went to bed at eleven and GB was still only half through with washing dishes. Somehow he was able to keep a half hour job going for five or six hours. An hour job could take days.

Oh, we enjoyed having GB around. Everyone liked him, as long as he wasn't around to exasperate with his slowness. We liked his little explanations for the constant disasters that enveloped him. He would come in with a sheepish look and say, "Heh . . . heh . . . had a little accident." Then, holding up a broken yardstick, he'd say, "Had this in my mouth and walked through a 30″ door."

Our boy has been working for six weeks, on a Vee beam for six meters. We made the mistake of publishing an article on the glories of Vee beams and this set him off. It only took a week to get the basic design worked out. This did present a bit of a problem, for it seems that he needed a 387.62 ohm quarter wave line to match the beam to our 200 ohm twinlead. GB made his own 387.62 ohm line by taking 450 ohm open wire television line and patiently moving one wire over about three quarters of an inch in the plastic spacers. One leg of the Vee went up without much trouble, but the other leg held him up. Trees in the way. Bib trees. Most of us would run the wire through the trees or put up something to hold it over them. GB worked out his own system. We now have a ten foot cleared path up through the woods for about 300 feet with about twenty one hundred year old pines lying chopped under the wire. Unfortunately GB got his angles a little bit off and we now have a

(Turn to page 74)

(W2NSD from page 71)

dandy Vee if six meters ever opens to Bermuda.

Well, I could go on about our other summer "help," but space here is limited. We'll be looking for a new crew next year. Have you thought about the possibility of spending a nice summer up in the beautiful mountains of New Hampshire?

Typewriters

Perhaps I can draw on the collected experience of 73 readers. Does anyone know of a typewriter that turns out the fine typing job (for offset printing) of the IBM Executive, but which doesn't need almost constant repairs? Hoot-Mon!

Polaroid

The new Polaroid 100 camera looked like it was just the ticket for a magazine editor. I bought one of the first out to see if it shaped up. I can report that it does an execllent job on black and white pictures, indoors, outdoors, or with flash. That little transistorized shutter control gives me perfect pictures every time, and this is valuable for magazine work. I've shot several packs of the color and am extremely disappointed with it. I don't know how the fellows in the camera magazines got those beautiful pictures, but mine all come out very dull and not much more interesting than black and white.

Poverty

There's a letter from a skeptic every week or so asking how I can plead poverty with a straight face while I am making trips to Europe, driving around in a Porsche, and keep telling about my big antennas and transmitters. It is difficult. But once you get used to being poverty stricken you can do almost anything you want without interfering with this state of mind.

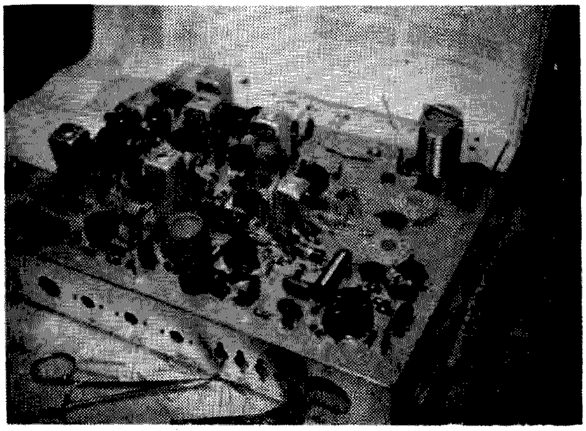
The philosophy involved may be difficult to accept. Basically it is to do as much as possible while spending the absolute minimum of money. This forces me to drive around ignominiously in a 1957 Porsche instead of a 1964, but it does get me around in a Porsche (pronounced por-sha). It means that in order to get over to Europe I have to tour direct 71 other people (which I enjoy anyway). It means that I have to swap off advertising space in 73 for equipment, make do with surplus at every opportunity and scrounge second hand gear whenever possible.

Being poor is fun.

. . . Wayne

The Heath HW-22 40 Meter SSB Transceiver

Charles Leedham WA2TDH



The Heath Company is right in the thick of the heavy current rush to SSB transceivers, their contribution being three one-band models covering 20,40 and 75. The prices of the non-kit transceivers coming out all over the place recently are enough encouragement to get started, finally, in sideband, but what could be more mouth-watering than a picture in a Heath catalog of a sideband transceiver with 200 watts PEP input, and for only 120? Not much. All of which sent me to the order blank in a hurry, bringing forth an HW-22, the 40-meter model. It wasn't as quick as all that, unfortunately, for the flood of orders for these units

and their 75 and 20 companions has the Heath factory backed right up to the eyeballs with clamoring hams, but they expect to be caught up by the time you read this.

As a transceiver, considerable of the circuitry of the HW-22 is used for both transmit and receive, thus saving space and cost. The carrier oscillator is used for carrier generation in transmit and for insertion in receive, both signals go through the same crystal filter and one common *if* stage, the VFO serves the functions of both, and the transmit grid and plate transformers operate also (in reverse) as grid and plate transformers for the recieve rf stage. All to the good, incidentally, because with this sort of transceive operation, you know good and well that when you're receiving somebody, you're automatically and infallibly set up on this frequency when you return his call. The major overall difference from the multi-use set-up of a small AM transciever is that the audio stages are kept strictly to themselves—the receive audio output is not used as the mike amplification on transmit.

For transmission, a 12AT7 is used crystal controlled for the carrier, and fed to a balanced modulator (four crystal diodes in a balanced ring) for combination with the audio coming in two stages from a 6EA8. The carrier is balanced out (45 db down) with a tuning control and the wrong sideband is chopped out at the filter, also 45 db down. The HW-22, by the way, operates only in LSB, *really* a single sideband rig, but the absence of USB capability is no absence at all, as 99.9% of the operation on 40 meters is LSB by a sort of general unspoken agreement. From the filter the signal gets another boost before it meets the VFO frequencies at the transmit mixer, then to a 12BY7 driver and two 6GE5 output tubes in parallel.

The receive section is single-conversion, with a 2.305 meg *if* for good image rejection. The passband is 2.7 kc at the crystal filter, and the arrangement gives quite good selectivity. A 6EA8 rf amplifier brings the signal in to the *if* stages, and the other half of the 12AT7 carrier oscillator is the product detector. Two halves of a 6EB8 operate as the af output stages.

Construction of the HW-22 is simple enough, and considerably more so because all the tubes, transformers, crystals, oils and all but two or three of the other components are mounted on one large circuit board. It still takes time, and about halfway through I had the feeling that I was stuffing parts onto the board by day and that someone was sneaking in at night to pull them our, like Ulysses' wife with her knitting. Nonetheless, it is an enormous constructional improvement over hand-wiring (as the TV-set

ads like to call it), because you never get to that normal kit-building point—where you know you are about two-thirds of the way through because it has become physically impossible to squeeze another part into that mess without hiring an elf with small tweezers to climb right in.

On this point, incidentally, Heath has supplied a major aid to overcome the complaints about the difficulties of servicing circuit-boards. Two pages of the manual are "X-Rays" of the board, showing the foil side and "through" it, the location of every component, numbered in relation to the schematic. This makes circuit tracing simple. Three other pages are given to charts of proper resistances at every point on the board, and proper voltages for receive and transmit at all pertinent points. Even before initial turn-on after construction, there are several stages of extra, point-by-point resistance checks to be made (the biggest list has about 60 checkpoints), just to be sure you've got everything in the right place and that there are no accidental shorts on the board from sloppy soldering technique—like mine. This aspect of the kit—as well as the basic transceiver design—has been well thought out by the people at Benton Harbor.

In operation, the HW-22 has performed quite satisfactorily. Operating into an inverted vee antenna at a rotten location in the middle of New York City skyscrapers, the transmitter gives enough punch to get good signal reports—good for readibility and all O.K. on clean signal —from one end of the country to the other, and the audio reports have been universally excellent. Provision is made for either push-to-talk or VOX, and the VOX circuitry performs admirably, picking up quickly and with adjustable release time. Relay click is very mild, and after a short period of operation is hardly noticeable.

The unit itself is quite pleasing in appearance, with a good, big VFO know and venier tuning for precision settings. The unit is used here as a base rig, but for mobile operation there is a gimbal bracket which can be screwed under the dash or even on the floorboard, with the HW-22 firmly held and tiltable to the most convenient operating angle.

Power requirements for the HW-22 are 800 at 250 ma peak, 250 at 100 ma, −130 at 5 ma for bias, and 12 volts filament at 3.75 amps. These requirements are of course met by the HP-23 power supply ($39.95) for the base, or the HP-13 Mobile supply ($59.95) for 12 to 14 volts. These solidstate power boxes also supply 6 volts for filaments and an adjustable (−40 to −130) bias for use with equipment other than the HW line. Power supply switching is handled remotely by the on-off switch at the transciever.

All in all, the HW-22 (and presumably the 75 and 20 models) looks like a hard unit to beat, especially at the price of $119.95. It tunes only 7.2 to 7.3 and has only LSB, but if you're going to operate SSB on 40, that's the only part of the band you can be in, and the only sideband you'll use. Add the ac power supply, and you're on 40 SSB with a respectable 200 watt PEP signal for only $160, which is mighty hard to beat. It is an ideal mobile rig, with very little final tuning ever needed, and for one-band base operation, it could even sit in the living room with hardly a sour note coming from other interested parties in the house. The cabinet is only 6 inches wide by 10 deep, hardly larger than a standard AM table radio in pre-transistor days. Poke the power supply out of sight under the table, and none of your friends will believe that you can talk across the country with that little box sitting there on the table. Of course, when you try to prove it to them, the band will be dead anyway, and they still won't believe you, but then that's ham radio for you. . . . WA2TDH

ham radio for you.

. . . WA2TDH

80 Words Per Minute

Old timers will be saddened to hear that Ted McElroy has passed on. Ted, one of the greatest CW operators of all time, could copy up to 80 words per minute and held the world's record at 73 words per minute. Few amateurs were not amazed to watch Ted at conventions copying code at these high speeds. He would start a tape at some easy speed down around 50 wpm and talk with everyone for a while then sit down and type with unbelievable speed. In a few moments he would look up and talk with agape watchers for a while and then type some more. Perfect copy. His sparkling wit will not be forgotten by the thousands who counted him their friend.

Voice of America

W2SKE's amateur radio program is broadcast every Sunday over most of the Voice of America transmitters. You can probably best hear it at 5:15-5:30 PM EST on 9530 kc, at 5:30 on 9720, or 5:45 on 9525 kc. Bill always has an interesting program so crank your receiver down and tune in next Sunday.

Larry

VHF'ers, particularly those with the Heath Two'ers, or those who will be getting Two'ers soon (and that should cover the field fairly well), should look into the modification kit being offered by Lawrence Engineering, 36 Lawrence Road, Hamden 18, Conn. The Twoer transmitter does a fine job, and the only problems fellows find with the unit is the receiver, which, though quite sensitive, blocks easily when too many stations come on the band. Strong stations can raise the devil with a superregen receiver. Lawrence Engineering has solved this problem with the "Super-Twoer" kit which transforms the Twoer receiver into a superhet, thus virtually eliminating overload problems. This also eliminates the receiver radiation normal to the super-regen and improves the sensitivity. All in all, for a couple hours work and $29.50 ($27.25 without tubes) you'll end up with a terrific transceiver. Everything goes inside the original Twoer; no cables hanging out, no outboard stages, no extra power required. W1JBQ and W1PXX have come up with a fine kit, look into it.

Automobile Gauge Noise Elimination

Edson Snow W2BZN

After pursuing the standard treatment on the spark plugs, the distributor, the generator and the voltage regulator of my Falcon, I became aware of a clicking noise that could be heard on the weaker BC stations. Apparently the noise was being radiated since it grew worse in an expressway underpass, and could be heard on a pocket transistor radio anywhere in the car. On a rough road, or by tapping the dash of the car, the clicking became a buzz. By-pass condensers didn't seem to help.

Using the pocket radio as a probe and pulling off wires here and there on the car, the noise was traced to the voltage regulator which supplies the fuel and temperature gauge circuit. The Falcon circuit (Fig. 1) is fairly standard in Ford cars and is probably typical of a number of other cars. A cheap and dirty solution is a toggle switch a "X" to kill the circuit while listening to a weak one. However you could run out of gas or boil over without warning. Besides it is not too hard to fix if you understand the working of the simple circuit.

Under normal driving, the battery voltage varies from 12 to 15 volts. With the ignition switch "on," the regulator contact is first closed, applying the full battery voltage to the circuit, causing the coil in the regulator to heat the bimetallic strip, which bends and eventually opens the contact. This drops the applied voltage to zero. The strip then cools; the contact is remade and the cycle repeats. Like the thermostat at home which cycles to provide a constant temperature in your shack, this regular can be adjusted to provide an average of five volts at its output. Of course a conventional voltmeter placed at this point would flop back and forth like crazy. However, the gauges on your car are a modern version of the old hot wire meters, which depend for deflection on the heating effect of the current rather than a magnetic field. The gauges have long time constants and therefore read average values. With what appears to the gauge as a constant voltage, the circuit becomes a simple ohmmeter measuring the resistance of the rheostat in the fuel tank or in

the radiator water. The Ford Motor Company advised me that each gauge has a current draw from 60 to 200 milliamperes at five volts.

What we need is a non-clicking regulator that will take an input that varies from 12 to 15.4 volts and supply a constant five volts to a load that varies from 120 to 400 mils. This is a good task for semiconductors. The circuit in Fig. 2 would be practical if a 10 watt zener diode at 5.1 or 5.6 volts were available, or if the automaker designed his meter circuit for 6.8 volts or higher, where the higher current zeners are available.

I used the circuit in Fig. 3. A 400mw zener is used as a reference voltage controlling an NPN transistor as an emitter follower to handle the heavier current. The resistors in the circuit drop the voltages and protect the semiconductors from surges. The capacitor was found necessary for one transistor that wanted to oscillate.

The NPN transistor is something of a problem since there are not too many inexpensive ones that will handle 500 mils. The only other factor to consider is the voltage drop between the base and the emitter, and this will determine the correct zener diode voltage to use.

The RCA 2N1486 is ideal but costly unless you can salvage one from an engineer's breadboard! It will handle ten times the current and becomes only warm to the touch with just its regular mounting bracket. A heat sink was not necessary, nor was the .05 capacitor. The base to emitter drop averaged about 0.2 volts on those tested. With a 5.6 volt zener

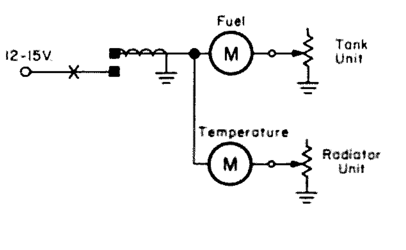


FIGURE 1

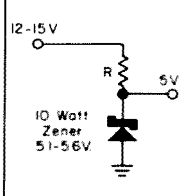
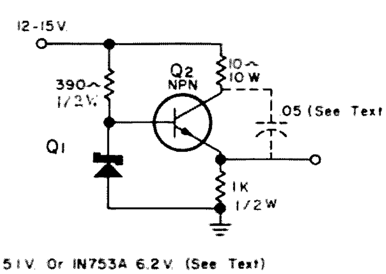


FIGURE 2



Q1 - IN752A 5.1V Or IN753A 6.2V (See Text)
Q2 - 2NI486 (RCA), 40053 (RCA) Or Equivalent (See Text)

FIGURE 3

(TI 1N753A), the output of the circuit held between 5.0 and 5.22 volts as the input voltage and load varied. It was quite satisfying to install this regulator and the original car regulator with a DPDT switch to be able to compare readings and convince the doubting that the noise can be eliminated.

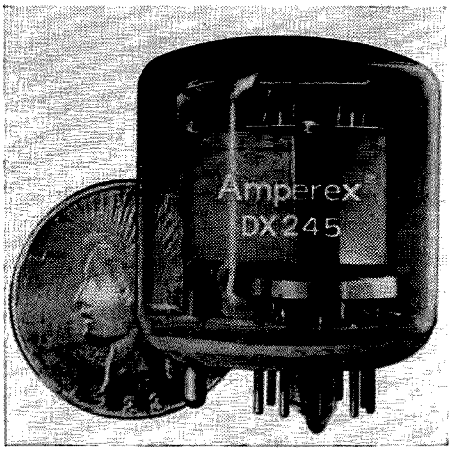
Since the 2N1486 goes for 13.20 net (at the recently reduced price) it doesn't seem a likely prospect for the ham trade, so I asked the local RCA rep to suggest something which would do the job more reasonably. After all there is nothing really precise about a gas gauge when there may be three gallons in the tank when the gauge reads empty!

The RCA rep suggested an RCA #40053 which nets for 1.40 in lots of 1-99 and can be obtained through local distributors. This is a silicon industrial NPN transistor in a JEDEC TO-5 package. It has a base to emitter drop averaging .7 volts among those tested. This means that the reference zener should be a 1N753A, 6.2 volts giving an output between 5.25 and 5.50 volts when the input varied between 12-15 volts and the load varied from 100-400 mils. This is a little above our 5 volt target but close enough for the car system. A 1N752A used here gave voltages under five volts. The maximum power dissipated by the RCA 40053 is 2.2 watts, therefore a heat sink is required. With the heat sink, the circuit ran all day long on the bench without heating too much. The .05 capacitor was found to be needed to tame some kind of an oscillation.

Construction is not critical. Just remember that the NPN transistor case can not be grounded to the car. Of course if your car has an ignition system with a positive ground, you can modify the circuit to use a PNP transistor and build it for "peanuts."

. . . W2BZN

New Products



VHF Power Tube

The new Amperex DX245 will deliver 40 watts up to 250 mc with only 1.5 watts of

drive. The heater is designed for 6 or 12 volt operation for mobile operation. Size is small and price is quite reasonable. Tube Division, 230 Duffy, Hicksville, N. Y.

Voltage Variable Capacitance Diodes

Texas Instruments has a new line of diodes which will have applications for remote tuning, harmonic generators, frequency modulation and frequency control. Capacities range from 22 to 47 mmfd at -4 volts. Designated XA580-XA589, they will be priced from $7 to $17. Box 5012, Dallas 22, Texas.

Shielded Subminiature RF Coils

J. W. Miller Company has a new line of coils that are magnetically and electrostatically

shielded and adjustable. They are designed for printed circuit applications and can be tuned from either the top or bottom of the coil. ½" square x ⅝" high. Fourteen different coils are available, 1.5 uh to 60 mh. 5917 S. Main St., Los Angeles 3, Cal.

Lo Pass Filter

Clegg Laboratories Model 372 low pass filter is designed to work with 52 ohm input and output and give attenuation of less than 0.5 db from dc to 50.7 mc, less than 3 db at 53 mc and more than 28 db at 55 mc. It has an adjustable notch which will provide 35 db of attenuation from 55 mc to 68 mc. Attenuation is more than 40 db above 68 mc. The 372 will handle up to 60 watts at 53 mc or lower, 120 watts below 51 mc and 240 watts below 30 mc. This is designed to keep your transmitter from interfering with TV signals and TV signals from blasting your receiver. Amateur Net $14.95. Four tuned circuits. Clegg Labs, Rt. 53, Mt. Tabor, N. J.

Letters

Dear Sir:

In looking through the November '63 issue of 73 AMATEUR RADIO, on Page 32 I noted with interest, that you had an article titled "All Band Conical Antenna."

Please be advised that our Company manufactures the 450 ohm feed line that you mention. There are two things that we think might be of interest to anybody using this device.

First, we make a special Stand-off, which is sold by both Lafayette, Burstein-Applebee and many other people, which makes it very simple to handle the open wire material. Second, the same device also permits accurate, inexpensive, stubbing down or up to 300 or 600 ohm terminations.

It might also be of interest to you, since you mention on Page 38, the fact that the open wire is hot with rf when transmitting, that we also make a formvar covered open wire, which, of course, is absolutely insulated. We also make a polyethylene type of open wire, which also removes the danger of rf burns, or shorting against any conducting surface.

In reading further, you indicate the fact that provision must be made for use of feed through and standoff insulators. We enclose a catalog, which will point out exactly what we are talking about.

Some of the other people that carry this material are Harrison, Harvey, Allied, etc., and many other places throughout the United States, that cater to the ham.

Incidentally, you also mention high resistance leakage to ground. The formvar covered open wire or the insulated wire will negate these conditions, obviating the necessity for wrapping the open wire feeders at the contact points, with plastic electrical tape.

Last, but not least, you mention metal guy lines. Please

note that we make fiber glass guy line, which is non-absorbent, non-radiating, high strength wire. This should also make your problem considerably easier, since we make this in varying tensile strengths.

We hope the above is of interest.

Edward Abbo, President
Saxton Products, Inc.

Do it yourself . . . almost

A. E. Hankinson W5EVL

For several years now, several companies in the Amateur and "other" fields have been producing printed circuit boards. It would probably take quite a while to catalog exactly how many different companies are in the field, but undoubtedly among the best known would be International Crystal of Oklahoma City. For years they have sold 6 and 2 meter converters, small transmitters, preamplifiers to the Amateur fraternity. In addition to International Crystal, other small companies like Gem Electronics and Vanguard Electronics have come forth with converters and low power transmitters completely wired on neat little printed circuit boards.

For reasons I will go into later, I became interested in printed circuits several years ago and in the course of searching out information on the subject, ran across an advertisement by Irving Electronics of San Antonio, Texas. By expending a stamp and envelope, I obtained Irvings Catalog. The original catalog I received had possible 70 or 80 different printed circuit boards. These differed from the International Crystal type in that they were not completed units. Instead, they were the bare board, laid out and marked for drilling and mounting of components.

The circuits which these boards represent are among the popular circuits found in the various magazines and from results obtained, evidently have been well checked out prior to release. Just about every field of interest in Amateur radio, with the exception of Amateur TV seems to be represented. This includes audio equipment and RTTY units. The majority of these units are on boards which will fit very neatly into one brand or another of miniature chassis box.

My primary reason for becoming interested in these boards was to obtain an inexpensive, and as trouble-free a circuit as possible for a Club project The Club had decided to sponsor "on the air" code practice sessions on 6 meters using MCW and it was felt that with a printed circuit board where the majority of wiring was provided, that those interested in the code sessions but with limited funds and technical ability, could avail themselves of one of these boards. The idea was, and I still think it is, a very good idea. Unfortunately, those of us interested did not get the thing rolling until

late in the fall and somehow or other I found myself dipping printed circuit boards into an acid bath to produce a locally designed board.

It pointed out one thing very definitely! Don't produce printed circuit boards with circuits that require a knowledge of circuitry for inexperienced or would-be amateurs.

Looking back at it now, I can see that the Club project which was classed a success, would probably have been rated a colossal achievement if we had been able to steer all those interested into something like the 6 meter boards from Irving Electronics or Gem Electronics.

Now-a-days, things are looking even brighter. Irving has come out with a much longer list of boards including quite a bit of transistorized equipment and in addition, a new company has appeared on the scene. P/M Electronics of Seattle, Washington have issued a catalog containing 43 different items including a transistorized auto ignition system, several nice sounding VFO circuits and others. I noted particularly that they have a 160 meter converter board which should be a boon to those who have no 160 meter band included in their receiver range.

These boards are particularly nice for those trapped family men who are unable to abandon the family for the shack in the garage and

yet are not permitted to bring equipment into the house. With these boards, one can work out of a small fishing tackle box as a parts and solder gun holder without upsetting the wife's nervous system.

While these boards as furnished by Irving and P/M will not satisfy the strictly "home-brew" types, they are a step in the right direction. Addresses for catalogs are Irving Electronics, PO Box 9222, San Antonia, Texas and P/M Electronics, Box 6288, Seattle 88, Washington.

You can mention my name but since they never heard of me, it will probably not influence them one way or another. . . .W5EUL

Improved Keying for the HT-40

Robert Foulkes K1UBP

About two years ago, the Hallicrafters Company brought out their multi-band low-priced transmitter, the HT-40. The author purchased one to use for stand-by and portable work. The HT-40 covers the bands from 80-6 meters, xtal controlled, and with a type of "controlled carrier" modulation. The RF section consists of a single tube as an oscillator-buffer multiplier driving the final amplifier. As could be expected, the keying note on the higher frequency bands suffered from this with a quite noticeable chirp on six and ten meters. This only happened when using xtal control as the external vfo was left running continuously while transmitting with keying being done in the buffer and amplifier stages. As much operation was done at K1UBP on six meter CW, the note had to be fixed. Rather than using a VR tube to stabilize the voltage on the oscillator, I simply cut the lead from the cathode (pin 1) of the 6CX8 oscillator from the keying circuit and grounded it. Now the oscillator runs continuously while transmitting

and the tone is a real T9X. If break-in operation is wanted, it is a simple matter to install a toggle switch to switch the cathode from ground to the keying circuit.

While the rig was out of the cabinet, a metering circuit was also installed to allow "tuning for a dip" in addition to tuning for a maximum reading. A wire as soldered to pin 3 of the 6DQ5 and the other end was connected to a pin jack mounted on the back edge of the chassis. Another jack was installed which went to ground. Then a 0-200 ma meter can be connected to the pin jacks to read the final's cathode current. A dpdt switch was installed in the meter case to switch the meter in and out of the circuit. Now the old familiar dip can be seen.

Still another minor change was incorporated at this time. The pilot lamp is a NE-2 and a keying monitor was needed. So, the pilot lamp was converted into a keying monitor as per W1ICP in the September 1957 issue of *QST*. Another NE-2 could have been used, but to save space and simplify mounting, the pilot lamp was ideal. Have you ever tried to operate with a bunch of outboard gear hanging from rig in a crowded dorm? Maybe you should try it some time!

. . . K1UBP

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR POWER SUPPLY. Voltage regulater adjustable power supply for running transistor equipment. Takes the strain off those transistor batteries. Great for the test bench. See April '63 page 8. Uses five ransistors, one zener, cute little (expensive) meter, etc. Will deliver up to 100 ma continuously, voltage from 0.35 to 15.0.
W1ISI $25.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... $20.00

TUNING EYE KIT. This kit enables you to install a dual tuning eye in any transmitter to indicate the tuning of two or more stages. It works far better than a meter or even meter switching. See page 22, July '63.
K6GKU $7.50

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a ener diode. Kit includes even the battery and mini-box.
K9ONT $5.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included. See Aug. 62 p 38.
W2LLZ $13.00

WRETCHED K2PMM

BADGES $1.00 each.

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ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

Ham-RTTY. This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

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PHILIPPINES	14	14	7*	7	7	7	7	7	7	7	7	14
PUERTO RICO	14	7*	7	7	7	7	7	14	14*	14*	21	14*
SOUTH AFRICA	7*	7	7	7	7	7	7	7*	14	14	21	14
U.S.S.R.	7	7	3.5	3.5	7	7	7	7	7*	7*	7	7

Good: 16-17, 23-25
Fair: 8-10, 12-13, 18-22, 26-27
Poor: 1-7, 11, 14-15, 28-31
Es: 8-10, 16-18, 22-24 (High MUF and/or freak conditions)

Items of Interest

January propagation looks pretty rough. This is typical of January during the LOW portion of the sunspot cycle. The best time for DX is during your LOCAL TIME morning hours if working EAST, and during your late afternoon and early evening hours if working WEST. In other words follow the sunlight on 14 or 21MC.

We have not yet reached sunspot minimum although it is quite low. The actual minimum should be reached, however, during the next 10 or 12 months.

73 Amateur Radio

February 1964
Same old 40c

YOUR VOTE COUNTS

Place
4c Stamp
Here

Institute of Amateur Radio
Peterborough
New Hampshire

IT IS TIME TO BE COUNTED

The ARRL claims that there is no point in running a poll on matters of interest because too few amateurs ever take the trouble to answer the poll. Please tear or cut out the postcard below, fill it out, stamp it and mail it. If you are against shredding your magazine then use your QSL card or a regular postcard . . . send something with the information requested. When you have accomplished this then get on the air and get as many other fellows to send in cards as you can . . . get everyone at your radio club to send in a card. Get on the phone and get every ham you can think of to send in a card. Let's make this 100% for all 73 readers and 200% for their friends . . . or better. Vote yes, vote no . . . but vote.

The results of this poll will be published in 73 and will be made part of the record on the proposal on file with the FCC. We will also see that the ARRL Directors get a copy of the poll results.

THE PROPOSITION

The ARRL has submitted a proposal to the FCC to make the Advanced Class license available to anyone who has held a General Class license for at least one year and passes an additional technical examination under FCC supervision. This license would be available to Conditional class licensees who have been licensed for at least one year and who pass the additional technical exam and a 13 wpm code speed test under FCC supervision. The new technical exam would be somewhere between the present General and Extra class license exams in difficulty. The present Conditional licenses could only be renewed in cases of the handicapped, overseas military or other hardships.

The present phone bands would be restricted to Advanced and Extra Class licensees as follows:

20 meter phone	July 1, 1965
40 and 15 meter phone	July 1, 1966
75 meter phone	July 1, 1967

No discussion of the arguments for or against this proposal will be given here. You can read the arguments in past issues of 73, QST, and CQ if you are not familiar with all of the problems involved.

Note [illegible] voted (opposed [illegible]) 11/21/64

Name ______________________ Call ____________

Address ______________________________

City ______________ State ________ Zip/Zone ________

I am a member of ARRL ____.

I am not a member of ARRL ____.

I am a member of IoAR ____.

I am in favor of the proposal ____.

I am opposed to the proposal ____.

I don't care one way or the other ____.

Remarks:

73

Magazine

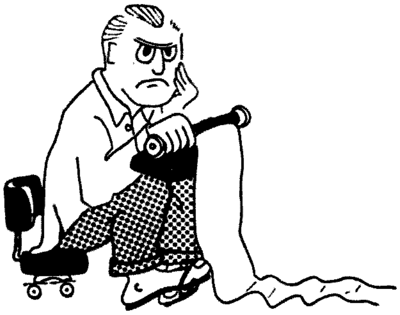
Wayne Green W2NSD/1
Editor, etcetera

February, 1964

Vol. XV, No. 2

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates have just been hiked (after considerable warning) to $4.00 per year, $7.00 for two years, $10 for three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A.

Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire.



de W2NSD/1

never say die

The turn of events would be comical if it weren't so serious. ARRL's bungling action has split our hobby catastrophically, making previous splits over such mundane matters as SSB/AM, AM/CW, Spark/CW, etc., appear like little wrinkles by comparison. As Mr. Kitrell of Hy-Gain points out in a letter to Mr. Hoover, "RM-499 is creating shameful dissension among amateur ranks. I do not believe that this dissension is a result of lack of information or anything other than the amateurs not believing in your incentive licensing program."

Or, as Milt de Reyna K4ZJF, General Manager of WEAR-TV, puts it, "You have the best answer to amateur radio's current problems in your editorial (January), only I wish you had given more space to it; we need a damned good Washington lobby so bad we can taste it. We need inept and downright misled and uninformed leadership such as Newington is providing about as bad as we need a good case of athlete's foot. As businessmen, you and I both know we'd fire, without a moment's hesitation, any employee who botched up a program as bad as ARRL has this one; I thought the last Chinese fire drill I saw was the classic example of a SNAFU, but I must defer to the new leader. I'm not now considering whether the ARRL proposal is good or bad; I'm talking about the League's almost naive lack of effort to sell the membership on its program, and above all, on the necessity of providing a united front to the FCC. We've now got one hell of a mess on our hands; the biggest thing we've lost is the League's standing in front of the FCC as a spokesman for the great majority of amateurs." Milt goes on to say, "The point is this—were it not for an experienced, excellent lobby, commercial television today could have been reduced to a shambles, and replaced by a government conceived utility that would have made us as potent as a newborn. I guarantee that amateur radio is going to have the benefit of the same type of thinking applied to it at some time in the future, and I wish to hell your warning in the current issue would have had a bit more mustard in it."

The ARRL Executive Committee met in early December and decided that everything was going all OK and that no changes needed to be made.

ARRL Executive Committee! ARRL Directors! Don't you fellows even read the articles in your own magazine? What are you thinking of? How can you desert us in this emergency? Did you miss the message which you printed in QST from the head of the amateur division of the FCC? Mr. Loucks spoke plainly and directly to *you*. He may have been addressing the QCWA, but he was talking to *you*. And *you* are not listening. Well fellows, some of us *are* listening. Didn't you even read the timely article by Prose Walker in QST? Prose has been on the U. S. delegations to ITU conferences for a long time now and you should *read* what he has to say.

The story from both Mr. Walker and Mr. Loucks is the same: things have slid long enough . . . changes must be made if we are to protect our wonderful hobby. And what have you gentlemen proposed as a course of action? You've handed us all a prize collection of clichés and a proposal for one of the most destructive rule changes imaginable. Thanks.

ARRL, you have failed not only the members you have pledged to represent, but you have failed all amateurs everywhere . . . and you've failed yourselves.

What *is* necessary for amateur radio to survive the next Geneva Conference with something resembling our present ham bands? What must we do to survive right here at home?

What changes must we make. What improvements are called for? While the amateur ranks are torn with dissension over RM-499 our date with fate at Geneva is drawing inexorably closer. We *must* act right now.

Here is what I propose we do.

1) Increase the Institute of Amateur Radio dues to $10 a year to provide the financing needed to have the Institute undertake tasks for which the ARRL is not now responsible. I feel that it is important that amateur radio be put back together, not split further, and therefore believe that we should attempt to have the Institute operate in areas which have been left open by the ARRL. This would make it important for amateurs to support both organizations rather than having to decide which one was the most important to support.

2) We have a great need for an office in Washington, manned by an amateur who can be reached whenever there is a question posed by any branch of the military, any government agency, or any Congressman. When matters of importance come up this man will know who to call for the best results. We can provide a steady stream of information about the service that amateur radio provides to Congress and government officials through such an office. We need badly to tell the story of public service that we render, the discoveries that are being made on the ham bands, and the international good will that we engender to everyone who can possibly help us. It is possible that we may even be able to expand to a full fledged lobby with our small Washington office as liason. We certainly have had adequate proof that we badly need all the push we can muster there. The ARRL has been under pressure for years to open a Washington office and has turned thumbs down time after time. One of the biggest allies we will be able to have on our side at Geneva next time is a U. S. delegation that has instructions to keep amateur radio strong. This was not part of the instructions last time . . . I know . . . I was there and I asked them.

3) Every now and then an amateur finds himself up against imposing legal odds. The usual result of this is that he puts in a panic call to the ARRL for help. The ARRL will give all the help it can in the way of legal references, but does not have funds available, as far as I know, to help the beleaguered amateur in his battle. This is not unreasonable, for this could easily run into hundreds of thousands of dollars a year. I do believe that there should

(Turn to page 83)

2 Meter SSB Rig

employing novel features

Richard Factor WA2IKL

Photo credit: Steve Schwartz WA2YDN

This project was started as an attempt to get on two meter SSB. That it was successful there is little doubt, but my aversion for controls and my desire to see what could be done with some of the more modern and unusual (for ham equipment) components led to the design pictured above. (Fig. 1). It is essentially a frequency synthesizer which adds the sum frequencies of two crystal oscillators and a VFO to give a frequency exactly 14 mc below any selected frequency in the two meter band. It is obvious that this frequency can be mixed with the output of any 14 mc rig to give two meter transmission and *reception.* Since this is possible, one can connect a transmitter and receiver tuned to 14 mc to the transceiving transverter and never have to tune either to operate transceive on two meters. Needless to say, it is a great advantage to have a tunable receiver, although a fixed-tuned one with a tunable transmitter could be used to work stations off frequency. Only the synthesizer and the associated control circuitry will be discussed here as the two meter receiving and transmitting converters are standard circuits. Many VHF men will be able to build the synthesizer portion and then plug its output into the crystal circuits of their two meter mixers.

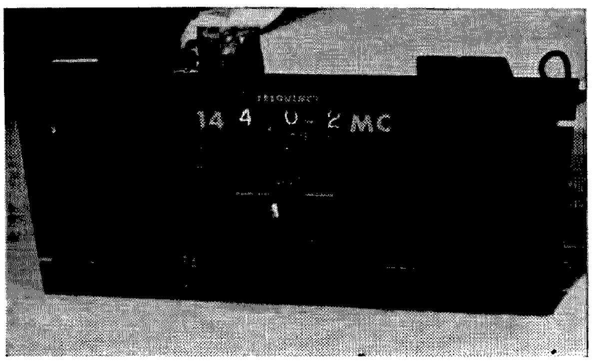


Fig. 1—Front view of unit: glowing numbers between the decals show the frequency range. The "interpolation oscillator" control—the VFO—is tuned by the vernier and the reading multiplied x 2 to give frequency in kc to be added to the above range.

Although I call the frequency determining circuit a synthesizer, it is not of the familiar kind in which many crystals are used to provide steps of 1 kc and a VXO to interpolate between individual kilocycles. For one thing, it is quite tedious to tune a band 4 mc wide by individual kilocycles. In addition, crystals are expensive. Therefore a VFO 200 kc wide is used for interpolation between ranges.

Many of you are wondering what the glowing numbers in Fig. 1 signify. The rest of you have a good idea and are wondering when I'll get to it. The author has always been impressed by the blinking of computer panels and industrial equipment and it has seemed a shame that almost all ham equipment has had nothing more impressive in it than a monitor scope or an occassional eye tube. Therefore, when I managed to acquire some Burroughs Nixie tubes, I was determined to do my best to alleviate this condition. Briefly, the Nixie is a neon filled tube with ten individual cathodes shaped in the form of the numbers one through zero. When a voltage greater than the firing voltage is placed across the anode and the selected cathode, a neon glow discharge occurs in the shape of the selected cathode. The method of controlling these tubes and the frequency is the second unusual feature of the unit.

The button labeled "Press for unit/Turn to

cycle" controls a 26 position stepping relay which selects crystals, tunes the plate circuit of a crystal oscillator, and selects which cathode of each of the Nixie tubes is to be grounded.

The actual circuitry is neither unusual nor difficult to construct. Referring to Fig. 5 it can be seen that the output of a VFO is mixed with the output of a crystal oscillator. The crystal frequencies (Y1-Y5) were chosen mainly because that series is readily available from at least two mail order surplus houses at a price of 50c each. The VFO frequency, 5.000-5.200 mc was chosen to avoid as many spurious products as possible and because it is a very common VFO frequency, and many published circuits, as well as quite a few units, are on hand in SSB stations. The output of the mixer goes to an amplifier whose purpose is partially to provide increased drive for the second mixer but mainly to compensate for the difficulty of broadbanding a circuit whose center frequency is 12 mc by a whole mc. The output of the "bandpass" amplifier goes to the second mixer where it is mixed with the output of an overtone oscillator. The output of this mixer is the final injection frequency which is to be mixed with the fourteen mc of the existing station. It is amplified by the second "band pass amplifier," but this time the main purpose is amplification, as the mixer output is not very great. After this amplifier, the detailed description stops, as the other circuitry is likely to be in existence or can be built from many articles. The two subchassis contail separately the transmitting and receiving converters. The only unusual feature is that the transmitting converter has no plate tuning

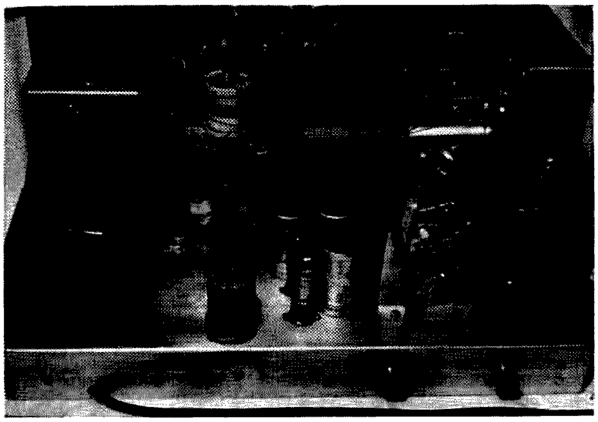


Fig. 2—Rear view: The stepping relay is in the case in front of the power transformer. All shields have been removed for this and all other photographs. The Nixie panel is visible on top of the front panel. Sockets on back are in order: switched 115VAC for linear, SO-239 output to 14 mc receiver, and SO-239 input from SSB exciter. 144 mc output is on subchassis.

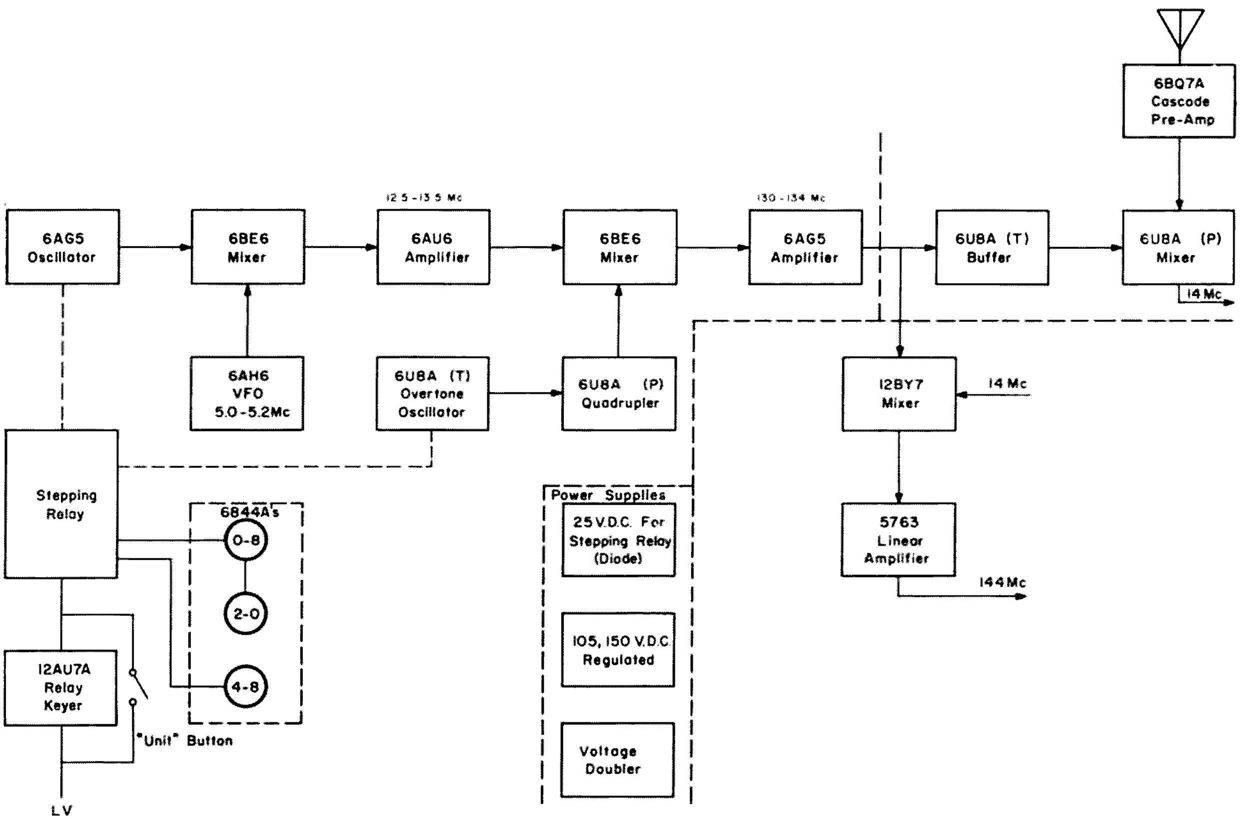


FIGURE 5

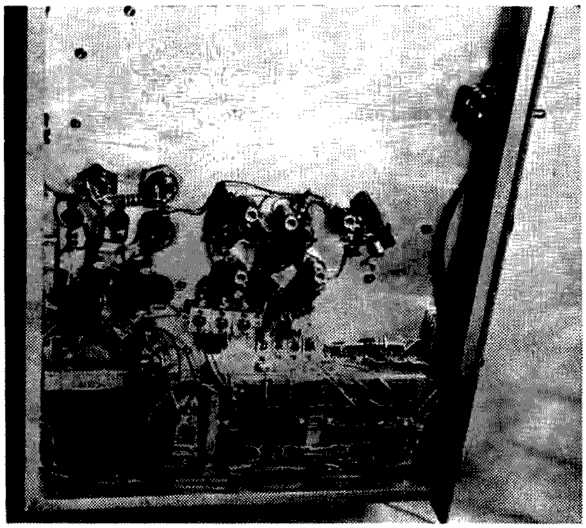


Fig. 3—Innards

control since the transverter is to be used with a linear amplifier with an AGC which will automatically compensate for non-uniform output. If it should ever be necessary to operate without a linear, all that has to be done is to drill a hole in the panel which will allow access to the tuning capacitor. (Incidentally, the large space on the bottom of the chassis is reserved for the addition of a fixed-frequency SSB exciter. This accounts for the absence of any complicated relay-switching arrangements.)

Getting the circuit to work properly is no problem. However, it is imperative to shield the top and bottom of the VFO to avoid an abomination of spurious responses in the converter which are probably the result of the harmonics of the difference frequency between the low-frequency crystal oscillator and the VFO. To remove all vestiges of spurious products, it is advisable to shield both crystal oscillators.

A few hundred words about the stepping relay and the Nixie tubes: Stepping relays are available as surplus and can come in many different types. The one used here was a 24 VDC unit with 26 positions and 12 wafers. Four wafers and all 26 positions were used. Figuring that there are only 5X4 crystals to be switched, it appears that six positions are useless. Actually I connected the first two positions (144.0-144.2 mc) in parallel, and the last five to cover the range of 148.0-149.0 mc. No crystals were provided for this range, of course, and it was included only for continuity. The double 1440.0-144. range is quite practical, because of the automatic switching system which will now be described.

Remember the button whose legend is . . . "Turn to cycle"? The button itself came from an old telephone and could easily be replaced by a center-off, spring return SPDT toggle switch. When the button is pressed, it grounds one end of the coil of the stepping relay, the other end of which is connected to a 25VDC supply. This advances the relay one step, giving a frequency range 200 KC higher. When the button is *turned,* it activates a modified POO-Key Jr. which is used to key the stepping relay at any speed the operator desires. No control is included to vary the speed because it is not anticipated that the operator will be in a hurry one day and not the next. If you feel yourself unpredictable, you can put a "QSY rate" control in. As a matter of interest, the stepping relay I used actually followed the 60 CPS of the power line, so set the keyer at as high a speed as you think your reflexes capable of. This is the reason the dual first position was included—to let the serious operator get home fast! Although I enjoy the relay very much, it is obvious that many will prefer switches to the expense of the relay and the somewhat tedious wiring required. The relay I used cost $10 on New York's "Radio Row," and similar ones are available from $3 to $12 depending upon condition and number of contacts.

The Nixie tubes used—Burroughs 6844A's—are the most readily available Nixie's. I was lucky enough to acquire a few which a friend thought were no longer needed in a UNIVAC installation. The sockets are 13 pin miniatures which I found by accident. It is quite possible that you will not be able to find Nixies at less than list price (about $15). If this happens, I will be happy to send a list of people who have tubes for about $5 each. As most of these people have only 6 or so tubes apiece, it is obvious that they will run out of them if only very few are interested. Therefore, if you happen to know where more are available at

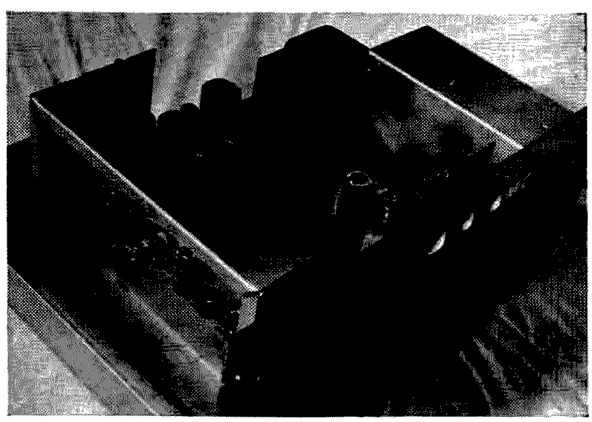


Fig. 4—Side-top view. Bottom of transmitting converter visible as well as some detail of the mounting of the Nixie's.

a substantial saving over list, please let me know. If you wish a list of the people who wish to part with the Nixie's (or have any questions about the article), please send a self-addressed, stamped envelope. If you feel the expense of the Nixie's is not worth the advantages, 10 neon pilot lights will do the job somewhat less elegantly (two of the Nixies are connected in parallel except for the fact that each electrode in I-3 is two greater than that in I-2).

Tuning the unit is not difficult if done systematically. The first step is to get the VFO to cover the proper range. If you use the one whose diagram is included, it is a matter of adjusting the VFO for five mc with the plates meshed by adjusting the shunt capacitor and the coil (either by adjusting the inductance with the slug if you use the surplus form or by spreading or compressing the turns if you use a commercial form). Then unmesh the plates. If the frequency is more than 200 kc higher, increase the capacitance of the shunt trimmer and reduce the inductance of the coil to preserve the five mc starting point. If less

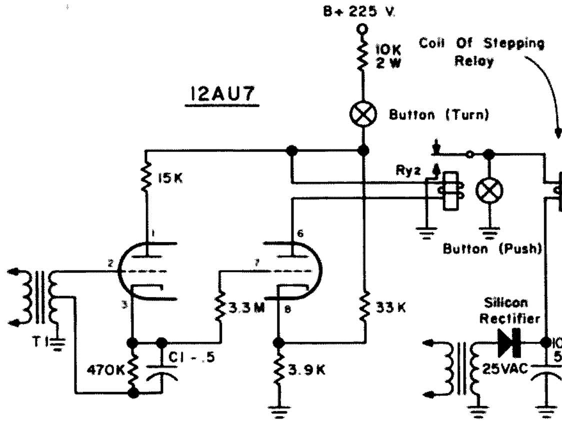


FIGURE 7

T1 Stancor A3856 or equiv, secondary not used.

RY2—6-10 K plate circuit (try to find one with not-too-flimsy contacts).

Button—see text.

C1—.5mfd, must be of high quality and low leakage.

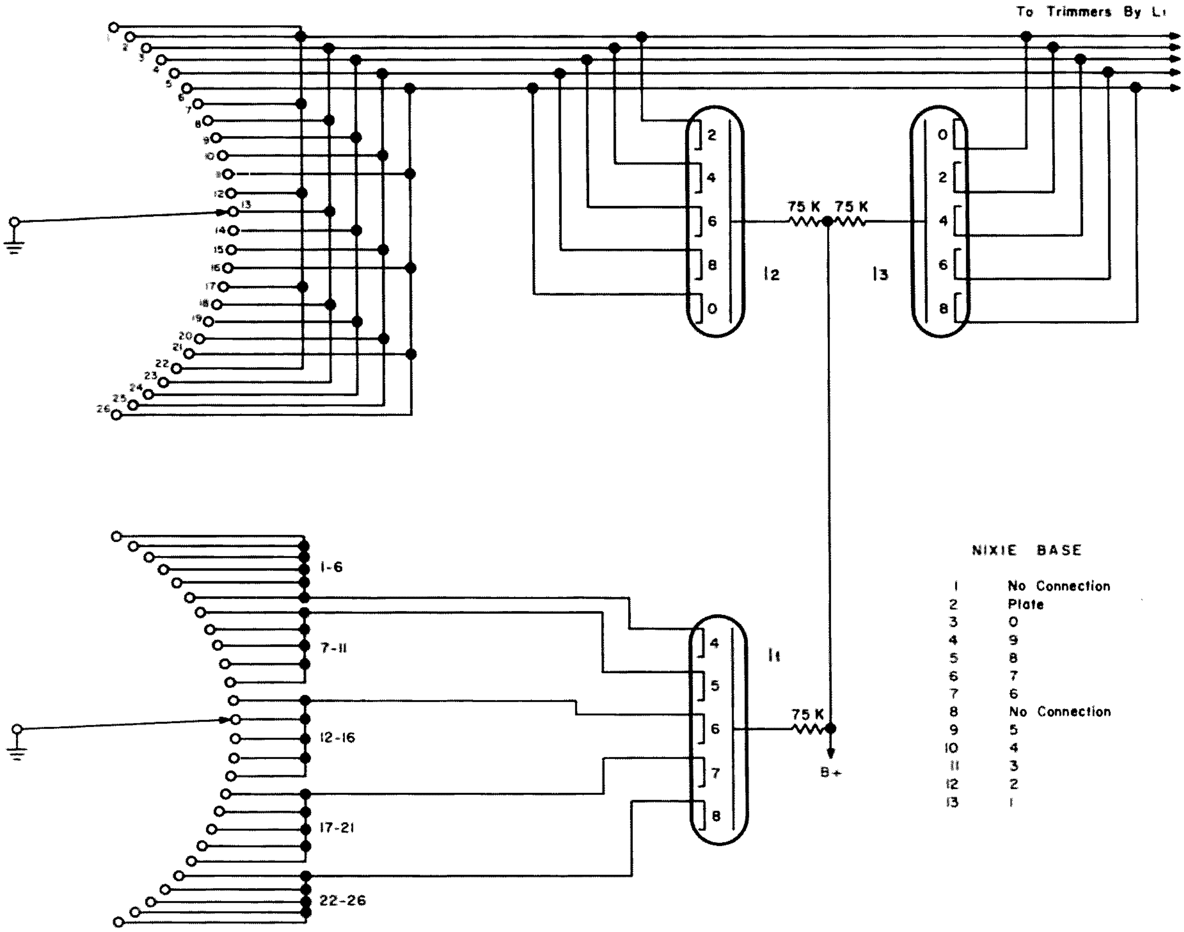


FIGURE 6

Diagram for wiring Nixie tubes to stepping relay. The crystal oscillators are wired similarly but to different wafers.

The capacitors connected to the top of L1 are trimmers for tuning the low frequency oscillator plate circuit.

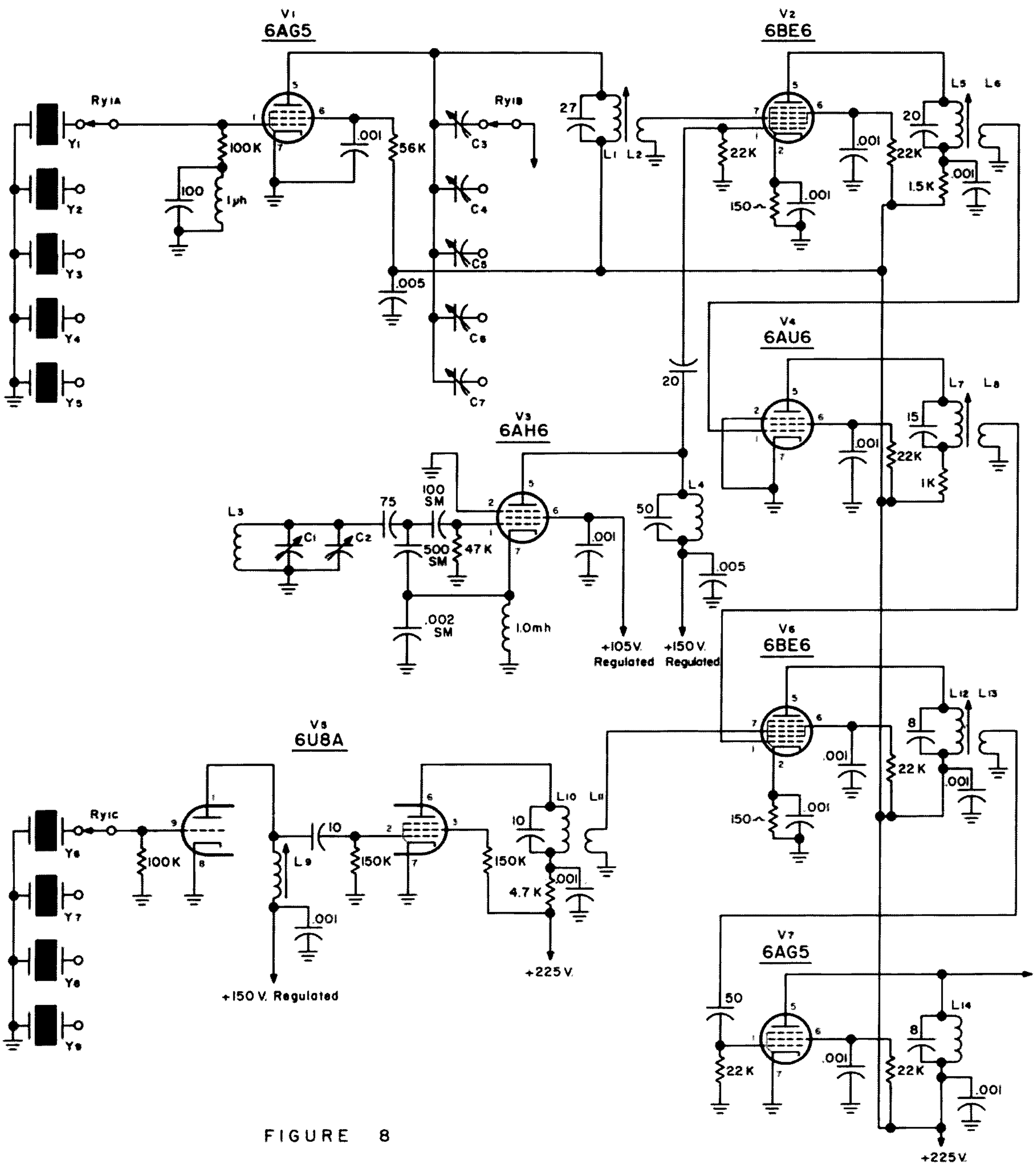


FIGURE 8

than 200 KC higher, do conversely. With the variable capacitor specified, tracking is excellent, varying by no more than 4 per cent at the middle of the dial. This is an error of 8 kc which is unimportant on 2 meters as it cannot put you out of the band. If greater accuracy is necessary, either a chart of reading vs. error can be compiled or you can experiment with other variable capacitors. The output coil is tuned for 5-1 mc and the output shouldn't vary significantly over ± 100 kc.

The first crystal oscillator is tuned individually for each frequency by the stepping relay. Set the relay in any five consecutive positions and adjust the associated trimmer across the output of the oscillator for maximum. If one extremely active crystal is encountered, tune the trimmer slightly off frequency so that the output is approximately constant.

The mixer output and the associated amplifier should first be tuned to 13 mc. Then one should be tuned lower and the other raised until substantially constant output is obtained over the 12.5-13.5 mc range.

The overtone oscillator and quadrupler should be tuned with the lowest frequency crystal in place (29.375 mc). The plate of the triode section of the 6U8A should be tuned through the third overtone frequency (that marked on the crystal) from the high end of the coil's range until oscillation starts. Then give the slug one more turn to insure stability.

Tune the quadrupler for maximum output and then raise its frequency until output just starts to fall off. This will compensate for the decreasing output as the crystal frequency is raised. The mixer output and the amplifier are tuned in the same manner as the previous mixer-amplifier combination.

The signal from the amplifier is yours to use, either according to the block diagram or in your own circuitry.

The overtone crystals used in this circuit will probably have to be ordered from a manufacturer as they are for uncommon frequencies. The 29.625 appears to be available in very limited quantity from Quaker Electronics. The other crystals are available from a number of surplus houses at 50c each. All may require a minute quantity of grinding if exact frequency tolerance is desired.

Operation

Because of the previous work, the stepping relay, etc., this is the shortest section: Turn the unit on. Look at the Nixie's to see what frequency range you're on. Turn the button until it switches to the range you want to be on. Turn the VFO to the desired frequency within that range. Period.

To many, the complete coverage of two meters may seem frivolous. I worry about the population explosion which seems to be outdistanced by the Ham Explosion. Those of you who don't worry will soon. I feel that all of two meters will soon be in use, and until then, there are nets and other reasons why the top mc is in use.

This system is also applicable to the lower frequencies, with perhaps a 20 kc VFO and crystals 20 kc apart. This would be simpler to tune than the two meter unit and for many would be more practical. The stepping relay-readout tube circuitry would be the same convenience. . . . WA2IKL

C1—50pf variable capacitor (Hammarlund MC-50 or equiv.)
C2—3-25pf compression trimmer
C3-C7—3-25pf compression trimmer
L-1—40 turns, #36 enameled on ⅜ in. iron slug tuned form
L2—2.5 turns around cold end of L1
L3—16 turns #22 enameled around coil form in BC458 series VFO (iron slug tuned) see text
L4—45 turns #36 enameled on ⅜ in. iron slug tuned form
L5—20 turns #28 enameled on ⅜ in. iron slug tuned form
L6—3 turns insulated wire over cold end of L5
L7—25 turns nr 28 on ⅜ in. iron slug tuned form
L8—2 turns insulated wire over cold end of L7
L9—20 turns nr 26 enameled on ¼ in. iron slug tuned form
L10, L12, L14, 5 turns #20 spaced one turn on ⅜ in. brass tuned form
L11—1.5 turns insulated wire over L10
L13—2 turns over L12
Y1—7500 FT243
Y2—7700 FT243
Y3—7900 FT243
Y4—8100 FT243
Y5—8300 FT243
Y6—29.375000 HC6/U
Y7—29.625000 HC6/U
Y8—29.875000 HC6/U
Y9—30.125000 HC6/U
(Y6–Y9) All third overtone
RY1—see text
I-1—13 Nixies—see text

Heath Warrior Tip

Present owners of the Heathkit Warrior KW linear amplifier model HA-10 may be interested in making their linear really a true KW amplifier with a very slight modification. I installed a toggle switch between the Power-On switch and the high voltage indicator panel light. This switch is used to shunt the swinging choke in the power supply. The net result—the no load plate voltage increases from 1600 to beyond 2,000 volts. In the CW mode, with 500 MA indicating on the meter, the plate voltage drops to just a shade over 2,000 volts. In the SSB mode I have been able to kick the meter up to 400/500 MA with no evidence of distortion of flat topping. I might add that I did not try this gimmick with the original 811A tubes in the linear, but did use UE 572As which have a greater plate dissipation capability and are directly interchangeable with the 811s. Although the 811s may not be capable of taking this maximum power in the CW mode at that voltage and current, there is no reason why the tubes could not withstand similar voltage and current conditions in SSB application. Just a note of caution: after about three hours of continuous roundtable QSO on SSB, the power transformer gets pretty warm. It is suggested that the "high voltage" position be used when the going gets rough. With the switch in the off position the choke is in the circuit and the linear amplifier is operating normally. Incidentally, the increased voltage from the power supply has no adverse affect on the meter, as the increase beyond 2,000 volts seems to be within the tolerance parameters of the meter. Similarly, no other deterioration on components was noted. On-air reports indicate an increase of talk power under most conditions with the higher voltage application.

. . . W2DOR

Simplified Receiver Design

become an instant expert

Larry Levy WA2INM/1

"Me design a receiver? You must be some kind of a nut! I don't even know exactly how they work" is the reaction of most amateurs when asked a question like that. Actually, most constructors are scared by the apparent complexity of a complete receiver schematic, and hesitate to consider building one, let alone design it. I must admit that starting with a blank sheet of paper and pencil can be quite a project, even for the technically experienced. Receivers, or any pieces of electronics equipment are not complex when broken down into individual circuits. The only difference between various receivers is the variation in circuit detail which are intended for different applications.

Basically, all receivers and converters are alike. There is usually one or more rf stages, the number and type depending upon the application, one or more mixers, one or more oscillators, one or more *if* stages, an audio amplifier and a power supply. The block diagrams of all receivers and converters are almost exactly alike even though the circuits may appear completely different. By having a selection of each type of circuit, a receiver can be designed for any purpose. In this article, I will try to explain how to combine several of the most useful circuits so as to make a good working receiver for almost any application.

To begin the design of the receiver, it is first necessary to know exactly what it has to do. The next step is to lay out a block diagram, listing each type of circuit (rf amplifier, mixer, oscillator, etc.). Next, choose the individual circuit of each type that most closely

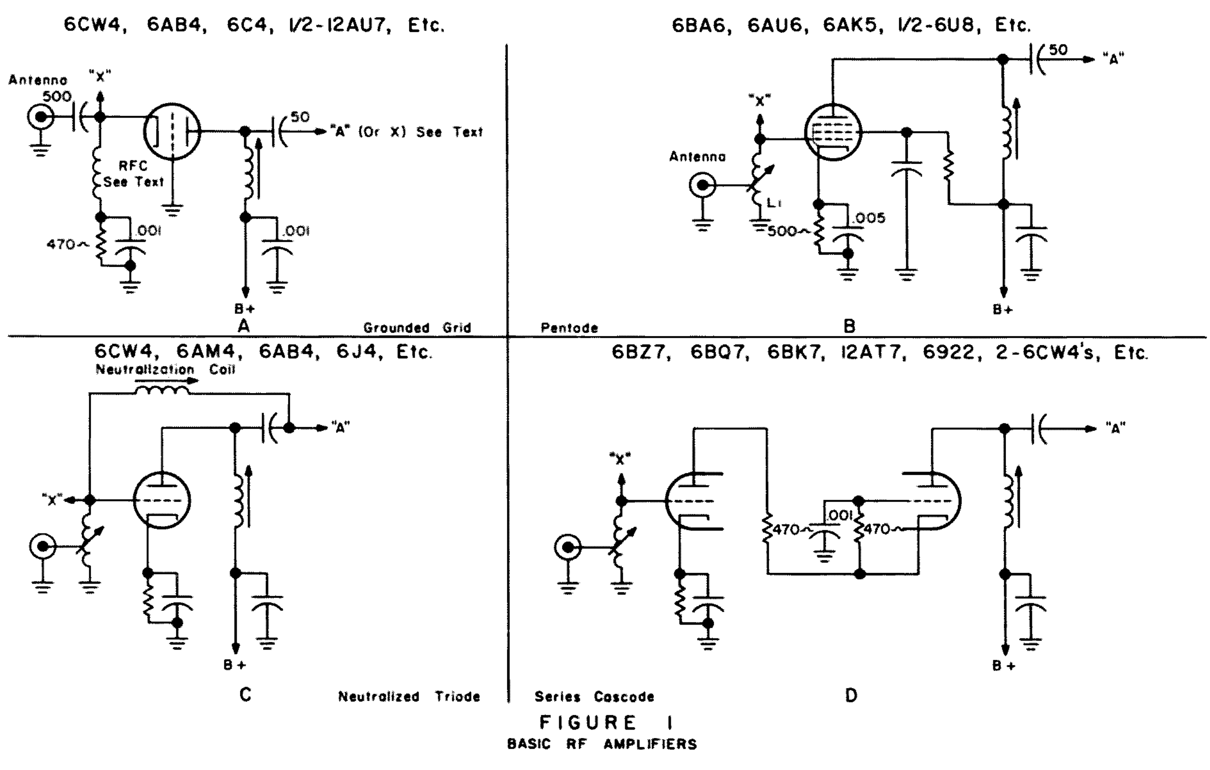


FIGURE 1
BASIC RF AMPLIFIERS

meets the requirements that you have set down. Then, it is only necessary to interconnect the points in the circuit that have the same letters, add the heater connections, and the design is complete. By using this method, even a newcomer can design a working receiver the first time.

The following is a list of the more useful circuits used in receiver design. While this does not come near covering all of the possible circuits, all of the more useful ones for most applications are included.

Rf Amplifiers

Fig. 1A. Grounded grid—A grounded grid amplifier is the simplest of the rf amplifiers given. It is extremely stable and will have an excellent noise figure when used with a low noise triode, such as the 6CW4 nuvistor. The disadvantages are low gain and possibilities of hum modulation. It is usually necessary to combine a grounded grid stage with another rf stage to have adequate gain. A circuit like the pentode shown in 1B will work fine. To combine them, it is only necessary to connect point "A" of the grounded grid stage to point "X" of one of the other stages shown. This will probably result in the best overall noise figure. The rf choke shown should be designed for the operating frequency.

Fig. 1B. Pentode—The Pentode is one of the easier rf amplifier circuits to use as it combines good gain with good stability. The noise figure is not as good as the triode circuits, but is quite useable on and below 50 mc. Only one stage is needed in most cases.

Fig. 1C. Neutralized Triode—The neutralized triode amplifier has good gain and a good noise figure. It does require some care and construction but will provide good performance with only one stage. It is more useful on VHF and when used with high gain low noise triodes like the 6CW4, 6AM4, 417A, and similar tubes.

Fig. 1D. Series Cascode—This circuit is widely used because of its high gain, good noise figure, good stability, and ease of construction. Its most common usage is in VHF circuits using any of the casode tubes available, although it could be used with two nuvistors, for example. On two meters, it may be necessary to replace the 470 ohm resistor with a small neutralizing coil to obtain the best noise figure.

Mixers

Fig 2A. Simple Triode—This is the simplest of the mixers given. The advantages are good overload characteristics, low noise, and

simplicity of construction. The disadvantage is that the gain tends to be low.

Fig. 2B. Simple Pentode—This provides more gain than the circuit shown in 2A. It does not have the noise figure or overload resistance of the triode circuits but is adequate for most cases.

Fig. 2C. Cathode Injection—This circuit probably has the best characteristics for a single tube mixer. Its gain is better than 2A but not quite as good as 2C. It has very high overload resistance and low noise. It does require somewhat more oscillator injection and is recommended for circuits using crystal controlled oscillators. The high degree of isolation makes it good for tunable oscillators at the lower frequencies where adequate drive is available as it will reduce pulling by the received signal. Most oscillators will not have enough output above 28mc (tunable oscillators) to drive this properly unless the plate voltage is raised to a point where stability is effected.

Fig. 2D. Twin Triode—This mixer has the highest degree of isolation between oscillator and received signal. Its high sensitivity makes it ideal for VHF tunable converters. It has good noise characteristics, good gain, and high resistance to overload.

Fig. 2E. Double Conversion—This is an example of how two mixers are combined for double conversion. Both mixers shown are of the type given in 2A. It is possible to use any combination of mixers. *If* frequencies should be carefully considered. The first one should be high enough to eliminate images and the second should be low enough to get the desired selectivity.

Oscillators

Fig. 3A Hartley—The most simple and relia-

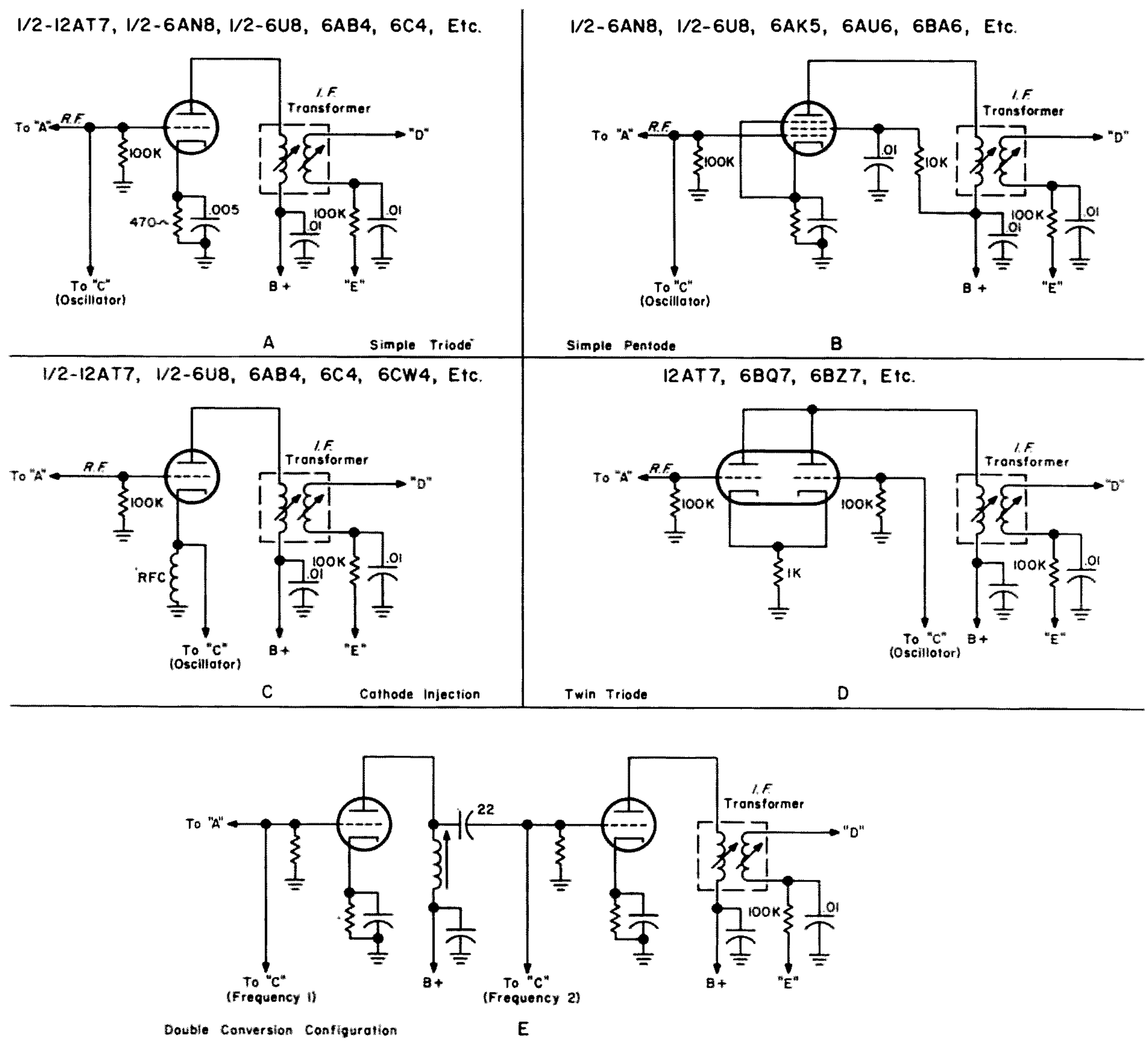


FIGURE 2
BASIC MIXERS

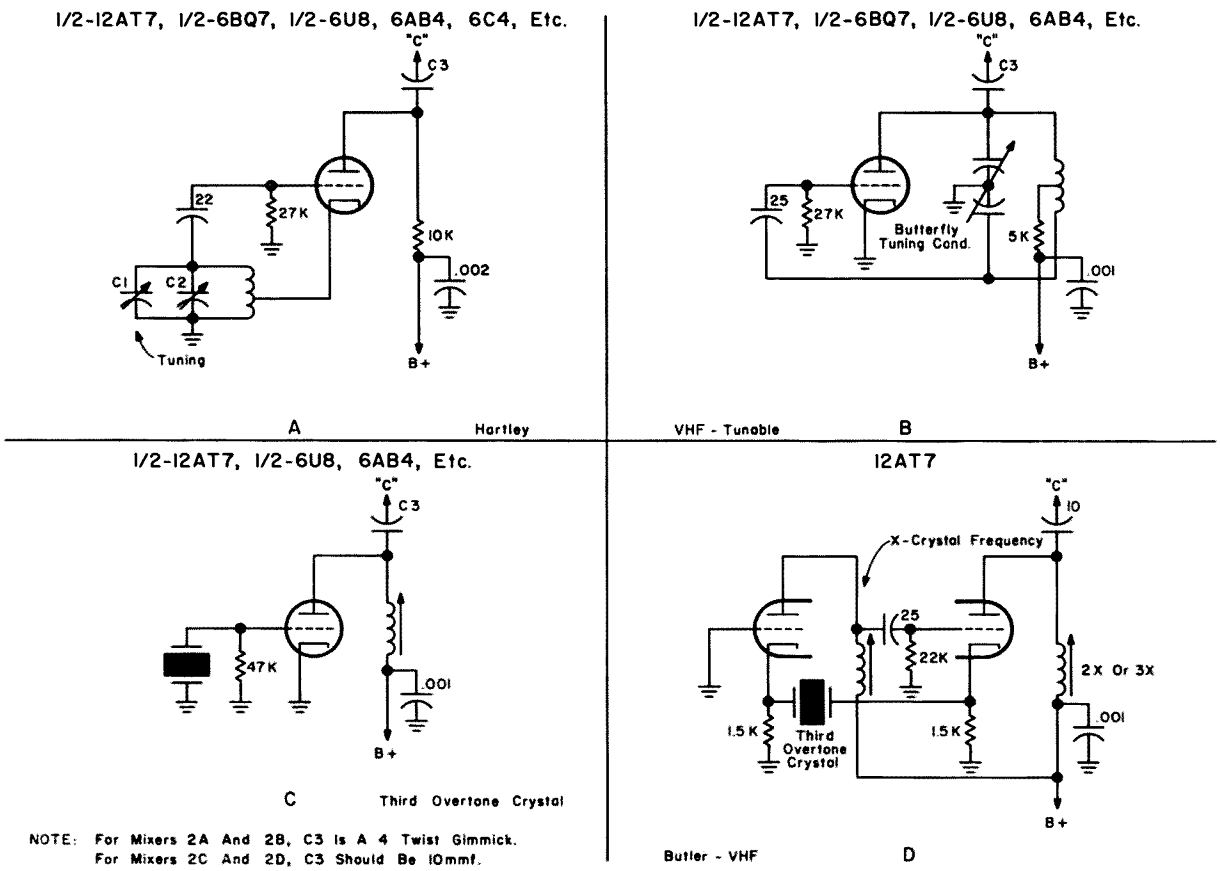


FIGURE 3
BASIC OSCILLATORS

ble oscillator for the lower frequencies. It has good stability and reasonably good output. The tap on the coil should be between 10 and 20% of the number of turns of the coil off the ground. C2 is a trimmer with a maximum capacity of between ⅛th and 1/3rd of CI. The circuit is good up to about 60 or 70mc.

Fig. 3B. VHF Tunable—This circuit should be used over 100mc because of its ease of construction. Using a butterfly condenser and a double-tuned coil, it is much easier to construct because of the size of the coil, which would be ridiculously minute in a single-tuned circuit. A very sturdy stiff-bearinged butterfly should be used, very securely mounted, with the coil soldered across the two terminals.

Fig. 3C. Third Overtone Crystal—This is used for fixed converters (tunable *ifs*) on VHF or the first conversion in a multiple conversion receiver. It has good stability and good output up to the frequency limit of the third overtone crystals.

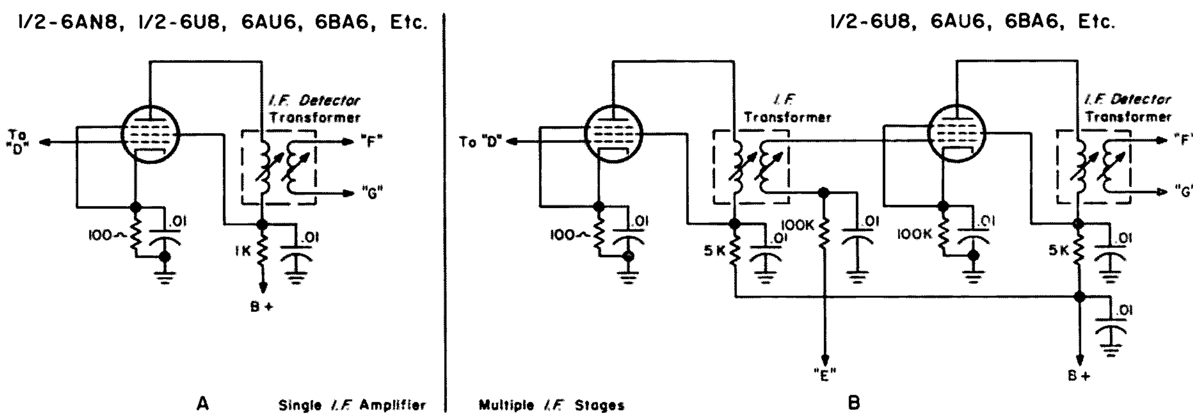


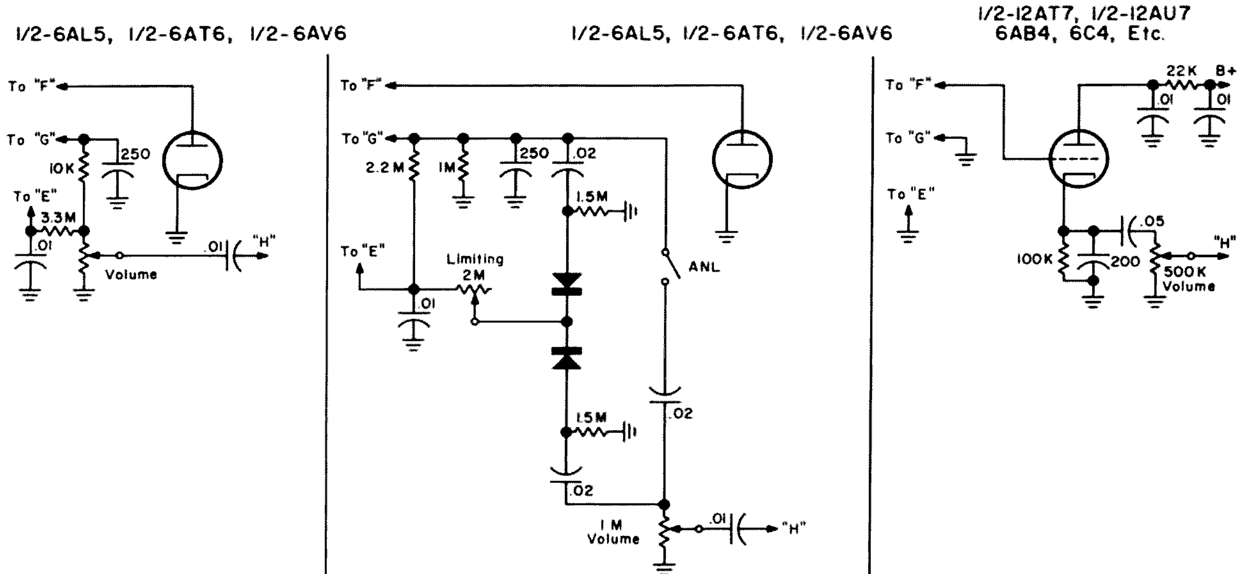
FIGURE 4
BASIC I.F. AMPLIFIERS

Fig. 3D. Butler—The modified butler oscillator is used for higher frequencies than can normally be obtained with third overtone crystals. Using a third overtone crystal, the output can be twice or three times the frequency, making possible easy converters for 220mc.

If Amplifiers

Fig. 4A. Single If—This provides adequate gain for most simple receivers. Using a reasonable frequency, satisfactory results, with respect to selectivity and sensitivity, can be obtained.

Fig. 4B. Multiple Ifs—These are used when a single *if* is inadequate. It is necessary to have more than one stage if a very low frequency is used for selectivity or gain will be low. It can also be used to build up selectivity using a high frequency with single conversion. Not



Simple Diode Detector
A

ANL Diode Detector
B

Infinite-Impedance Detector
C

FIGURE 5
BASIC DETECTORS

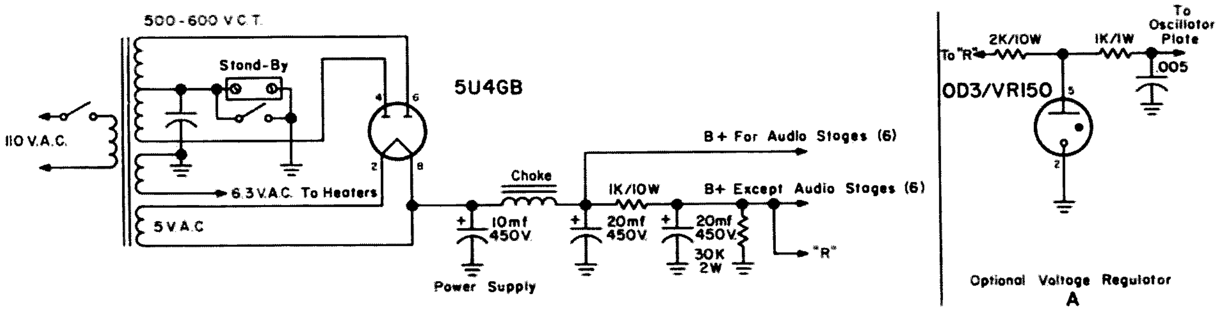


FIGURE 7

more than two stages are recommended, as stability becomes a problem.

Detectors

Fig. 5A. Simple Diode—This is the most commonly used detector. It has good output and provides adequate avc. It is usually found combined with some kind of a noise limiter.

Fig. 5B. ANL Diode Detector—This circuit combines the detector shown in Fig. 5A with a full wave series limiter. The limiting control should be adjusted for 100% modulation on an average signal.

Fig. 5C. Infinite Impedance—This detector, while not widely used, has one good advantage. It can be used to obtain high selectivity from a signal *if* stage as it does not load down the last *if* transfomer like a normal diode, therefore giving better selectivity. Overload resistance is very high. The disadvantage is that there is no avc.

Audio Amplifier

Fig. 6. Audio Section—This amplifier will

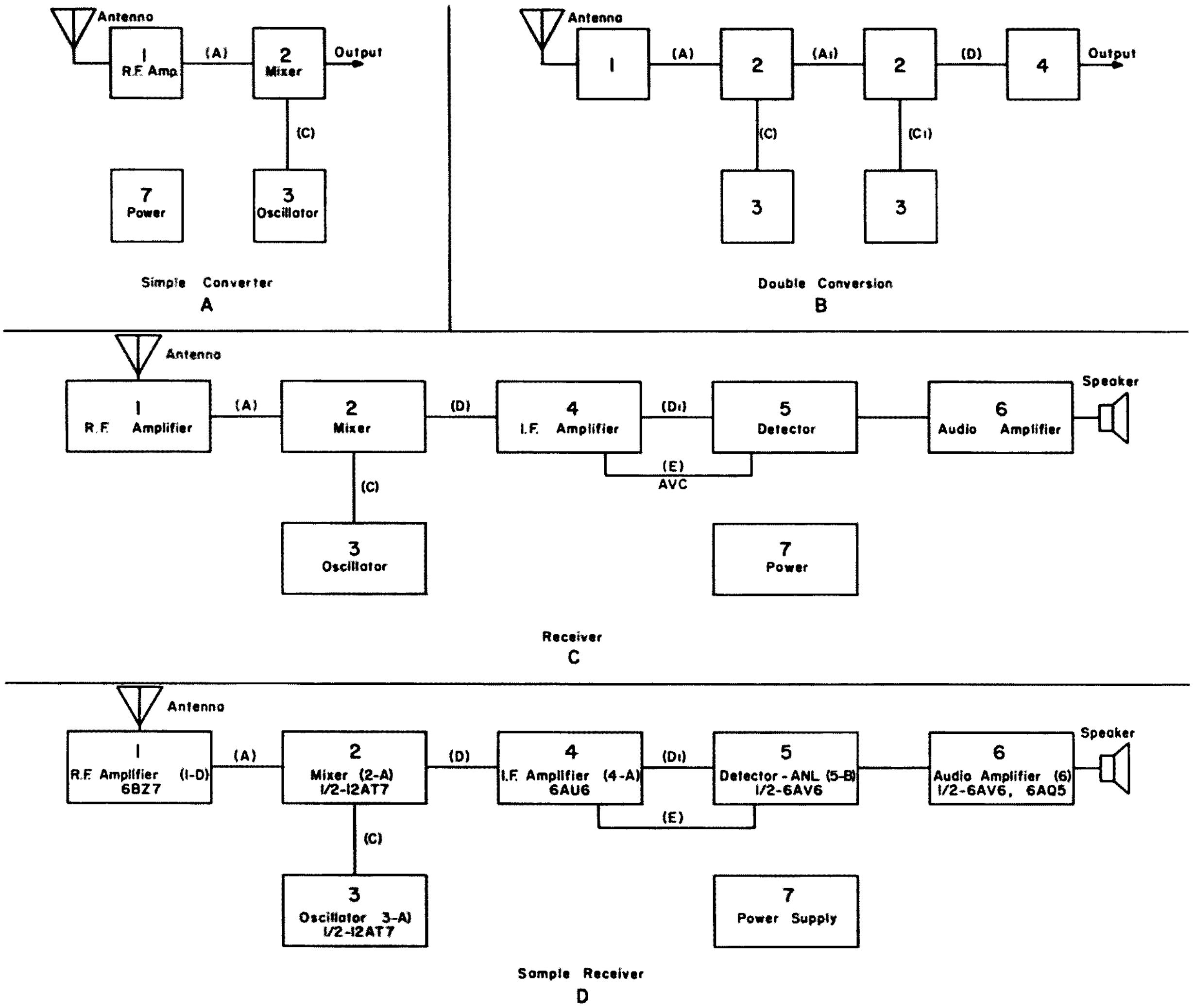


FIGURE 8

CORRECTION

In the Europe on $2000 a day article last month the printer got the fellows in the RSGB photo turned around. Apologies. We'll continue the story next month.

work well with all the circuits shown. It has good gain and adequate output.

Power Supply

Fig. 7. The power supply recommended is a full wave one giving about 250v output. Filtering should be good to prevent hum modulation of the oscillator. Silicon diodes can be used in place of the 5V4.

Block Diagrams

This is the real secret in receiver design. First calculate what characteristics a receiver should have. After deciding whether it should be a simple or complex, single or double conversion, etc. receiver, lay out block diagrams

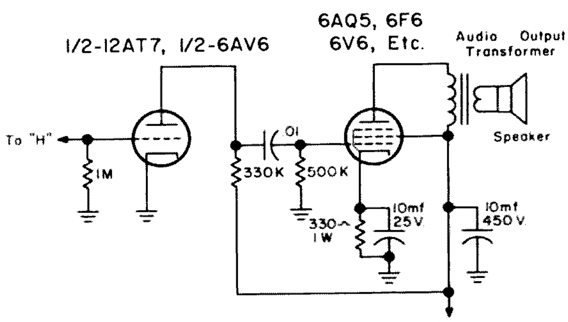
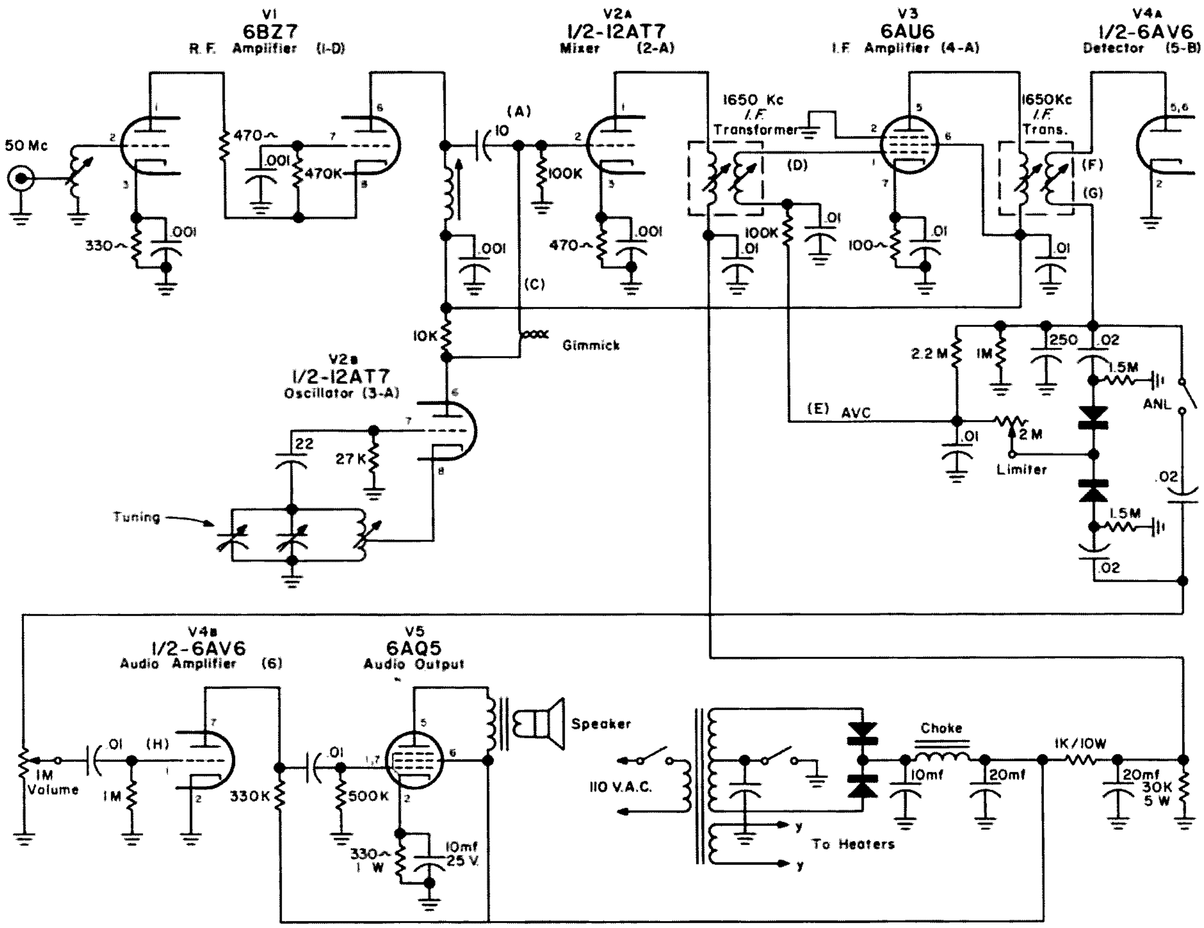


FIGURE 6
AUDIO SECTION

of the type shown in Figs. 8A, B, and C. Next determine performance characteristics by choosing the individual circuits to go in each box, using a combination of circuits to meet the various requirements you have chosen. All the circuits given here will work in any combination with satisfactory results, so it is therefore possible to use any oscillator with any mixer with any rf amplifier, etc. This leaves quite a large combination of possible receiver circuits that can be designed to meet any specific requirements. Fig. 8A shows a block diagram for a simple frequency converter. It can either be fixed or tunable, depending upon the oscillator circuit chosen. This would be the basic design for a VHF converter. Fig. 8B illustrates a double conversion configuration for a more advanced receiver. One of the two oscillators is tunable, almost invariably the second one. Fig. 8C shows a block diagram for a complete single conversion receiver. Just to illustrate a point, I am going to design a complete receiver using the block diagram shown in 8C. It is going to be a 6 meter single conversion receiver, designed for monitoring and general hamming. I want it to have reasonably good gain, a good noise figure, moderate overload resistance, somewhat broad selectivity so I can use it on nets, and a noise limiter. For this purpose, the best rf amplifier would be the Series Cascode. Looking in my junkbox I see a 12AT7 and a 6BZ7. I figure that the 6BZ7 would be good for the rf amplifier, so that I can use the 12AT7 as an oscillator-mxer. Consulting my chart, I find that mixer 2A, utilizing one-half of a 12AT7, meets the necessary requiremets. The other half is used as an oscillator in circuit 3A. Now that the front end is designed, pencil in the numbers of the diagrams and tubes into the boxes. Next add an *if* stage, the one shown in 4A being fine, a detector–arl as shown in 5B, an audio amplifier and a power supply. A 6AU6 makes a good *if* amplifier and a diode-triode like the 6AV6 is good for a detector and first audio. According to the requirements an *if* frequency of around 1650 kc is chosen as it combines good gain, moderate selectivity, and fair image rejection for a 50 mc receiver. It is also necessary that there be *if* transfomers available for the frequency chosen. Next, add the interconnecting lines, and the block dia-



Receiver Schematic

FIGURE 8-E

gram is complete. The next step is the drawing of the schematic. Look up the diagrams and copy them on paper, connecting signal points with similar letters. Now add B plus lines and heater leads from the power supply, and the design is complete. The complete schematic and block diagram for this receiver is shown in Figs. 8D and 8E. After checking the schematics for errors, get out your soldering iron and get to work.

. . . WA2INM/1

Making a High Value AC Capacitor

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The trick of making a high-value ac capacitor from a pair of electrolytics connected back-to-back as shown in Fig. 1 is so old it has a long gray beard.

But there's a way of doubling the capacitance of the resulting unit, as well as providing a little better voltage-rating protection of both electrolytics.

When connected back-to-back as in Fig. 1, the two electrolytics are effectively in series, so that the resulting ac capacitor has only half the capacitance of either unit alone. In addition, all the reverse-polarity voltage is impressed across whichever capacitor happens to be the "wrong way" during any half-cycle, so that a fairly high margin of safety is required in the voltage ratings.

But by adding a pair of semiconductor diodes connected as shown in Fig. 2, the ac is converted to dc so far as the capacitor is concerned. It remains ac, however, on the outside of the composite unit as each half-cycle passes

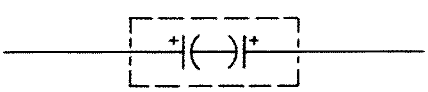

FIGURE I

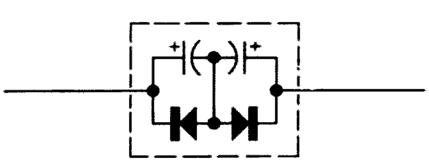

FIGURE 2

through its own diode and capacitor and the two halves are re-joined at the output.

Since only one capacitor is in the circuit at any time (the other being shorted out by its diode) the effective capacitance rating is equal to that of a single capacitor, or twice that of the simple back-to-back hookup.

And since reverse-polarity voltage is shorted out from the inactive capacitor, no excessive safety margin in voltage rating is necessary. The capacitors need only be rated to withstand dc equal to the *peak* value of the ac voltage impressed across them. The diodes must also be rated for this PIV.

In audio and similar applications, type 1N34 diodes may be used. In power applications, silicon power rectifiers are fine. A 120 mmfd 120 vac capacitor may be built using 120 mmfd 200 vdc electrolytics and 200 PIV rated diodes; 450-volt capacitors and 400 PIV diodes are good up to 275 V rms.

One of the more common ham applications of this trick is in repair of antenna rotators. Most of the present-day rotator designs use a large-value ac capacitor to control direction of rotation. Typical ratings are 100 to 150 mmfd, and the rms voltage is nominally 24 volts. Capacitors of this type are not usually found in our junkboxes, so that if the capacitor goes out we must order a replacement from the factory. Using this trick and a pair of 100 to 150 mmfd, 50 vdc electrolytics (of the same capacitance rating as the original unit) together with 50-PIV diodes (or the more common 400-PIV types if you happen to have them on hand) you can get the rotator back in action almost immediately.

. . . K5JKX

Heat Dissipating Tube Shields

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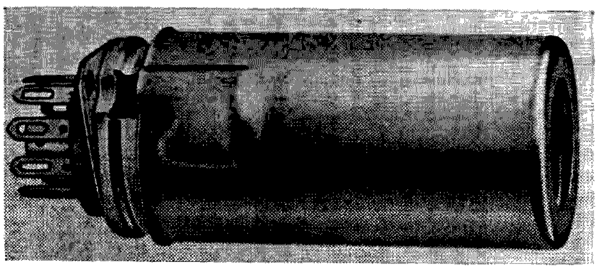
Huntington Sta., N. Y.

"Show me a man who has never replaced a tube in his rig and I will show you a man who has not figured out how to turn his rig on."

The subject of amateur equipment failure is one which is often discussed like the weather, but no one ever does anything about it. The use of heat-producing vacuum tubes in receivers and transmitters is here to stay, at least until the time that transistors with their inherent longevity gain an increased measure of acceptance. For the moment, we are concerned with failures in any piece of equipment which uses heat-producing vacuum tubes.

Some of us may never have had to change or replace a tube or have had to send a rig back to the manufacturer for repair. This depends very heavily on the degree to which the rig is turned on. Also, if you trade it in very often, you won't have much of a servicing problem. What now follows will not be of much interest to this minority. We will be concerned with prolonging tube life, and as we shall see later, this is accomplished by reduction of tube operating temperatures.

Toward the end of World War II, the U. S. Military became interested in determining the cause of unreliability in electronic equipment. They performed many surveys and studies, directly and through contracts, the outcome of which showed two basic facts. First, resistors and capacitors caused between 6 and 7 percent of the failures, and vacuum tubes showed more than 75% of them. Secondly, the greatest single cause of tube failure is high operating temperature. While resistor and capacitor life is definitely affected adversely by elevated temperatures, their failure rate is small, com-



The Jan type kilter shield.

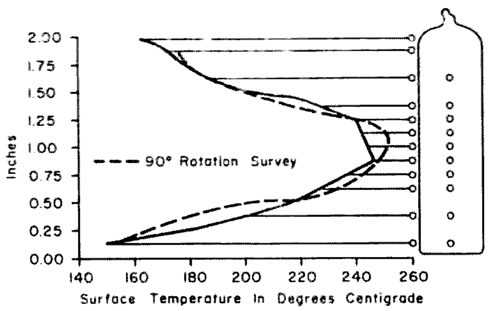


FIGURE 1

6005/6AQ5 operating at maximum plate dissipation (45° ambient temp).

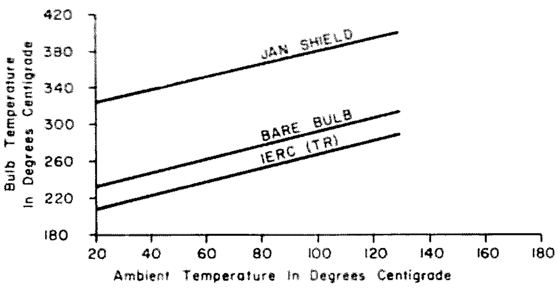


FIGURE 2

Bulb temperature vs. ambient temperature in 3 cases.

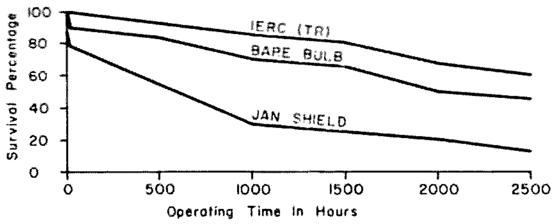


FIGURE 3

5654/6AK5W—total dissipation. 2.97 watts in 100° C ambient. Bare bulb temperature 190° C.
Envelope temperature's effect on tube life in 3 cases.

pared to that of tubes, and will not be discussed any further at this time.

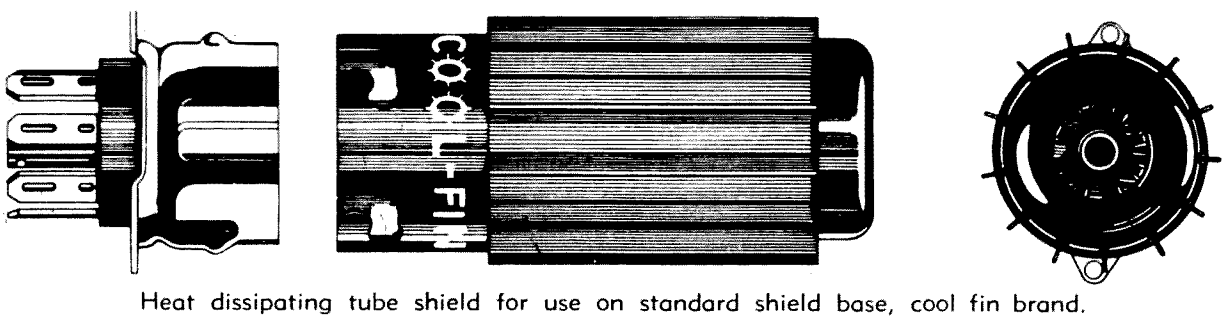
How are we as purchasers of commercial grade ham receivers, transmitters and tubes affected by this survey? First, the poor record of tube failure as stated above must be considered an optimistic one, for the tubes tested in the various studies were the pre-aged MIL variety. It would be difficult to say what we can expect, but we do know that many tubes exhibit premature failure. Yet we know of some tubes which have held up phenomenally well. Let us simply conclude that on the average, the commercial tubes which we use will never give performance which exceeds the military tubes.

What are the causes of tube failure? First, any equipment manufacturer who puts the shiny JAN type of tube shield on a tube to act as an electrostatic shield is planting a knife in the back of the consumer. As we will see, the shiny metal tube shield is a killer, and actually shortens the tube's life over no shield or bare-bulb operation by a considerable amount.

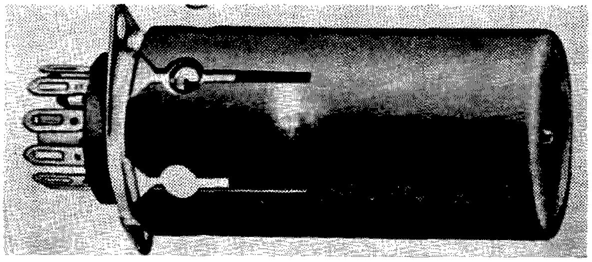
How hot do tubes get? Fig. 1 shows how the temperature of the bulb varies for the 6AQ5, a hot-running tube. The center of the plate is the hottest spot, and the adjacent glass bulb is nearly 100°C hotter than the coldest part of the bulb. Now we ask: how does the operating bulb temperature affect the tube's life? Intuition tells us that the hotter the tube runs, the shorter it will last. Finally we ask: how do we get the tubes to run cooler? To this question there are two answers. Forced air cooling, which is required of most high-power tetrodes, may be used. When forced air is applied properly by using a chimney, and in adequate volume, it effectively reduces the bulb temperature. It would be impractical to use chimneys for all of the tubes in an exciter. Very often a blower is furnished to move the air around, but unfortunately, not all of the tubes benefit by this action. If a hot-running tube is up-stream in the air flow from a cooler-running tube, the latter may actually run hotter than one without the forced air.

Well, if you read the title of this article, you can guess what the answer to the tube temperature problem is—the heat dissipating tube shield. This device does the same job of electrostatic shielding as the JAN type, but that is where the similarity ends.

As shown in Fig. 2, the bare bulb runs cooler than the JAN shielded combination, and the heat dissipating tube shields run cooler



Heat dissipating tube shield for use on standard shield base, cool fin brand.



Heat dissipation tube shield for use on standard shield base. (IERC brand).

than the bare bulb. This means that for maximum tube life, the heat dissipating tube shield should be used whether electrostatic shielding is a factor or not. Fig. 3 answers the obvious question of how tube envelope temperatures are related to tube life.

The typical heat dissipating shield consists of a metal shell which has been given a coat of flat black paint to maximize heat radiation. It contains a beryllium liner which has hundreds of fingers stamped into it. The fingers enable the liner to fit closely to the tube bulb and transfer the heat from the bulb to the black shell. From there, the heat is radiated away, convected by air currents and conducted down through the shield base and into the chassis. This results in the temperature reduction as shown in Fig. 2.

Sizes, types, availability and cost are all on the side of the consumer. The first producer of these shields is IERC, International Electronics Research Corp.[1] and a newer company with a somewhat different (and according to them, better) design but fewer different sizes is Cool-Fin Electronics Corp.[2] Both produce shields for all common 7 and 9 pin miniature tubes, and IERC has a full line ranging from subminiature tubes through 6146 types on to shields for Eimac 4-400A tubes.

If you are willing to make an investment in a heat dissipating tube shield which costs less than the price of the tube being protected, you should write to the manufacturers or their representatives for complete catalogs. Much data is available from them, and it is too much to be presented here. These shields are low-cost insurance which will minimize your rig's down time and your yearly tube replacement expenditure. They may be easily installed and later removed if you decide to trade in the rig.

. . . K2ENN

[1] 135 W. Magnolia Boulevard, Burbank, Calif. Distributed by B. B. Taylor Corp., 2270 Grand Ave., Baldwin, N. Y.
[2] 1717 N. Potrero Ave., South El Monte, Calif. Available direct.

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More on the Magic TR Switch

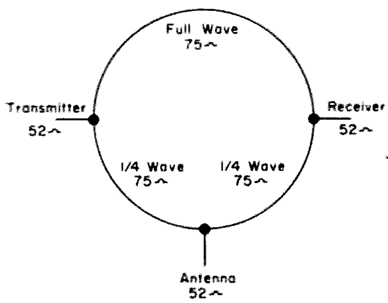


FIGURE 2

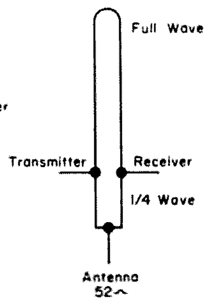


FIGURE 3

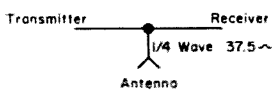


FIGURE 4

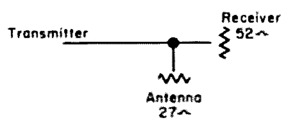


FIGURE 5

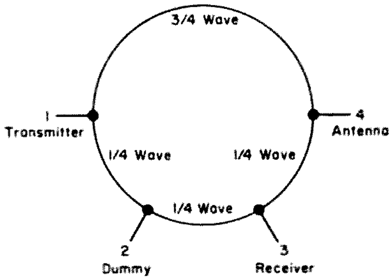


FIGURE 6

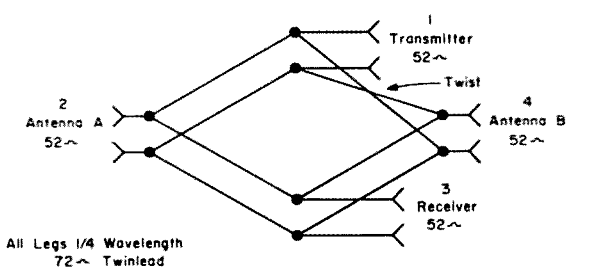


FIGURE 7

The ink was hardly dry on the August, 1963, issue of this magazine (which carried, on page 20, a description of the "Magic T-R" switch) when a letter arrived from Bob Flint W4MSK, who had some rather cogent objections to the idea.

"It isn't a balanced bridge the way he drew it," complained Bob, who then went on to prove his statement.

And so, despite checks by several rather knowledgeable antenna experts who liked the idea and like the author completely missed the flaw, it must be said that the original Magic T-R is one of those fine ideas which went astray.

But all is not lost! A method of overcoming the flaw has been found, and you can still use this no-moving-parts gadget. Before pointing out how, let's take a look at the details of Bob Flint's objection:

First we have to look at the accompanying sketches. There is no Fig. 1 so don't look for it. Fig. 2 is the same as Fig. 2 of the original article. Figs. 3, 4, and 5 were supplied by Bob in his proof why it was no good.

Note that Fig. 3 is the same as Fig. 2, except that the line has been arranged in a somewhat different shape. All connections and lengths, however, are identical. The full-wave line can be replaced by a direct short with no change in characteristics, which brings us to Fig. 4. Fig. 4 also shows the 75 ohm lines as a single 37.5 ohm line, which is their net effect.

Now we perform the impedance transformations to find out what the line from the transmiter sees, and come up with 27 ohms at the antenna port and 52 ohms at the receiver. With such a load, the antenna takes 66 percent of the power—and the converter input

gets 34 percent! This is distinctly not good for converters.

So Bob is completely correct in his statement that "the only way such a Magic Tee, Rat-Race, or Hybird Ring can be used is to have proper terminations at the proper places."

But when you put a 52 ohm dummy load on port no. 2 of Fig. 6, then half the outgoing power reaches the antenna and the other half is dissipated in the load. Similarly, on receiving, half the incoming signal reaches the converter and the other half is lost in the dummy. No serious VHFer, or low-frequency man either for that matter, wants to take a 3 db loss in signal-to-noise ratio, so at this point it would appear that the Magic T-R is slightly dead.

However! Several years ago in a QST article, an important point regarding VHF dummy loads was made. Discussing tune-up of a 220 mc kilowatt, the writer of the QST article commented that "at this frequency and power level, probably the best dummy load available is a well-matched antenna mounted in the clear."

Many serious VHF operators are already using stacked beams of one sort or another. Others are using multi-element broadside arrays. In either case, it's usually not too much trouble to split the feedline arrangement in half and run two feedlines, so that one half of the array may be connected to port 2 and the other half to port 4! This arrangement employs an antenna as each dummy load, so that an outgoing signal will be fed to both antennas and no power will be lost. Power loss on an incoming signal should also be negligible.

One important point about this arrangement—signals at ports 2 and 4 are 180 degrees out of phase with each other. This anti-phasing must be corrected somewhere between the T-R and the antenna itself, either by lengthening one feedline a half-wave or by reversing connections to one set of antenna elements. Otherwise you'll end up with a null dead ahead and most of your power going off in unwanted directions.

Finally, Bob offered another bridge arrangement which takes up a little less space than the coax hybrid ring; it's shown in Fig. 7, and is made out of 72 ohm Kilowatt twinlead. The 180 degree extension between ports 1 and 4 is achieved by twisting the line a half turn. This design, Bob advises, is based on an article which appeared in the Proceedings of the IRE some 10 years ago.

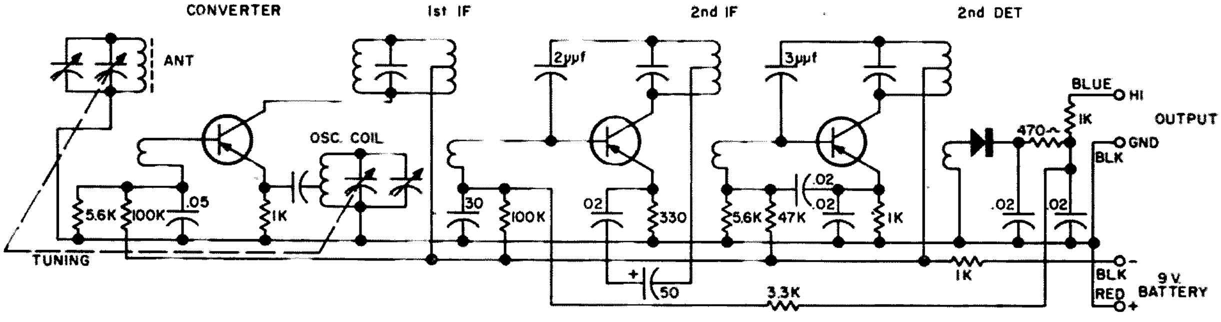
Isolation between transmitter and receiver in the coax version probably won't be greater than 35 db—which is about the same that is attainable at VHF with ordinary coax relays. The twinlead version offers better than 30 db isolation over a 2-to-1 frequency range. But these isolation figures are true *only* if all ports are properly terminated.

So, as we said the first time, try it and let us know how it works out. And many thanks to W4MSK for his comments!

Miniature, Transistorized, AM Broadcast Tuner

Rufus Turner K6AI
Photo courtesy of Lafayette Radio

There are many experimental uses for a small AM broadcast tuner, but few hobbyists will undertake to build one. The new Lafayette PK-633 subminiature printed circuit tuner is entirely factory-built and (at $7.95 net) costs less than its transistors and other parts. Because such a tuner is useful not only as a broadcast receiver but in many other applications, I



checked the performance of the PK-633 to obtain more data than is supplied by the manufacurer.

A full superhet circuit with avc is employed (no reflexing); the stage lineup consists of a converter, two *if* amplifiers, and a diode 2nd detector. Audio output (0.05 v rms on weak Los Angeles stations, 0.2 v rms on the strongest one) is sufficient to drive either a transistor- or tube-type audio amplifier. (The tuner even puts a comfortable signal into high-impedance headphones, without an amplifier.) Selectivity is close to 10 kc. Dc output is 0.1 v at 100 microamperes—enough to operate a 1-transistor dc relay. Powered by a 9-volt battery, the tuner draws 1.3 milliamperes.

Only 4" long, 1¾" wide, and 2" high, it may be fitted neatly into other equipment. It weighs ½ pound and has only four leads: two for the battery and two for the output. Ferrite antenna is self-contained.

In addition to its intended use as an entertainment device, a miniature, ready-made, battery-operated AM broadcast tuner has the following experimental applications: (1) *if* and 2nd detector channel of a transistorized shortwave receiver or field strength meter, (2) remote control receiver, (3) metal detector receiver section, (4) tunable broadcast-band signal tracer, (5) broadcast-band field strength meter, (6) test probe for shield room inspection, (7) radio interference meter (8) sensitive capacitance relay, (9) baby sitter receiver section, and many others.

. . . K6AI

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Hector French W1JKZ
9 Davidson Road
Wakefield, Mass.

Loud Speakers and Enclosures for Phone

You've just set up your umpteen-tube communication (it says here)-type receiver . . . dial lights are on . . . antenna is connected . . . all ready to go except for the speaker. Well, this one looks all right—came from that old AC-DC was kicking around here a few years back . . .

Hold on a minute there. That speaker is going to be the final link between the other fellow's mike and your ear-bones. That makes it a pretty important part of the system; how about finding out first how to pick out a better speaker for amateur phone use, or at least how to make the best use of the one you have? Sound reasonable?

One of the first things to think about, then, is the speaker's transient response. Transient response is hard to measure, and even harder to understand once you've measured it—but for us phone men, it's easy. After all, we know that "transient response" is only a conditioned-reflex noise an engineer makes when he can't figure out why his design doesn't do what it was supposed to (and hopes he'll find out before someone catches him at it). While for us phone men, "transient response" merely describes what the speaker does with a sharp pulse of interference—like one spark of ignition QRM.

Here's what one short, sharp pulse of interference could look like, for example. Fig. 1 shows the audio signal *into* speaker from the receiver.

You'll see the single noise pulse: higher amplitude than the audio, but of extremely short duration. Now see what a speaker with a poor transient response would do with it (Fig. 2).

What has happened is that the noise pulse has shock-excited the speaker into vibration, and wiped out a piece of the audio signal you're trying to hear. Worse than that, this burst of vibration has a masking effect, so that it sounds much louder and longer than it really is; this is all guaranteed to spoil the percent intelligibility.

Of course, any well-designed receiver will have some sort of noise clipper in it, or some other kind of circuit which is supposed to chop off these high-amplitude pulses before they get all the way to the speaker. But none of these circuits are perfect; a certain amount of interference will always come through somehow. Even the audio itself will have a lot of short, sharp pulses: the sounds corresponding to the letters "p" and "k," for example. A poor-transient-response speaker will react to the "p" and "k" just the same as for any other short, sharp pulse.

Luckily, there are some definite choices you can make to help assure that your speaker will probably have a good transient response. The first thing is to use a speaker with a heavy magnet. "Heavy" doesn't necessarily mean pounds; a few ounces of this year's magnet material will do the same job that a pound of

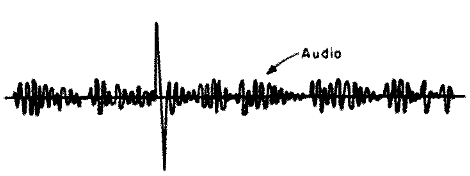


FIGURE 1

Audio signal to speaker, with single high-amplitude noise pulse.

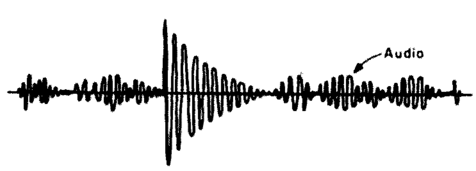


FIGURE 2

Sound from speaker, same electrical input as Fig. 1.

magnet was needed for, ten years ago. So as a usable rule-of-thumb, look for a heavy magnet.

Another detail is to drive the speaker from a low-impedance source. This will be more helpful with a heavy-magnet speaker than with a light. You're stuck with whatever audio stage you have in your receiver, so that short of re-designing the output, about all the help you can expect here is to use the low-impedance output tap: connect an eight or ten ohm speaker to a 3.2 ohm tap, for example.

You can also improve the transient response by acoustic damping; this comes up later on with the information on speaker mounting and enclosures.

Transient response isn't the whole story, though. You also have speaker linearity to think about. If your speaker is non-linear, it generates distortion components and cross-modulation products which weren't present in the signal fed to it. Bad enough to have QRM from the outside without generating any more of your own! With a linear speaker, you still have a chance of copying through the splatter from a neighboring phone station. With a non-linear speaker, this same interference isn't just an unwelcome intruder on your QSO—instead, it smears the signal you want to the point where you can't understand what the other fellow is saying.

Here's why: let's pick a moment when there happens to be only two frequencies coming into the speaker from the receiver (109 and 585 cycles, say) (Fig. 3).

A linear speaker would reproduce this audio pretty much as shown in Fig. 3—but now see what happens with a non-linear speaker:

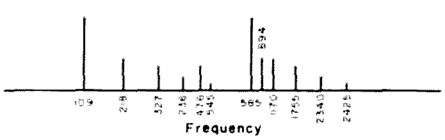


FIGURE 4

Sound output from non-linear speaker, showing harmonics and cross-modulation products, same input as Fig. 3.

The speaker has not only generated harmonics of each of the two frequencies, but has also generated the two sum-and-difference cross-modulation products—and this shows only what happens with two frequencies. You'll usually have five or ten different frequency components at the same time going into the speaker—can you imagine the mess that would come out of a non-linear speaker then?

Luckily, the non-linearity problem is handled the same as that of transient response;

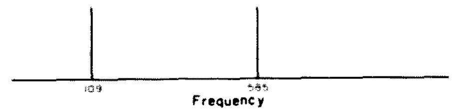


FIGURE 3

Frequency spectrum into speaker from receiver, at moment when only two frequencies are present.

the same recommendations apply. If you want to insure good linearity, look for a speaker having a heavy magnet and a generous power rating.

When it comes to frequency response, the old reliable 300-to-3,000-cycle rule-of-thumb is as good as any—but that's not the whole story, not by your Aunt Matilda's ear-trumpet, it isn't. What happens both inside and outside this band-width is important, too.

For instance: the response curve of a loudspeaker (if you can believe what the curve says) will always be a ragged and jagged sort of an affair. The only thing is, some speakers have a smoother response than others. The smoother the response, the better your chance of 100% intelligibility.

You'll want a reasonably flat response between these 300 and 3,000 cycle limits, too. The only thing better than a "reasonably flat" response is one which rises smoothly at the high end, and then drops off; this gives a little extra snap to the high-frequency speech components for a crisper voice quality. Avoid a response which includes a resonance peak, whether contributed by the speaker or its enclosure. A high-frequency resonance adds a harsh, gritty quality, while a mid or low frequency resonance obscures the high-frequency audio components, and makes "sh", "ch", "z", "s", and "th" all sound alike. No matter where the resonance is located, listening fatigue comes up, and the chances of a 100% QSO comes down.

So now comes the big question: how *do* you go about the job of picking a speaker to answer all these requirements? You'd have to be a loud-speaker engineer, seems as how.

Not so. There's a good rule-of-thumb here, too. If you'll study the catalogs put out by the

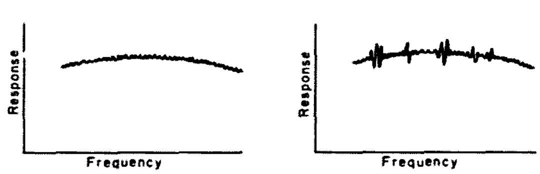


FIGURE 5

Comparison of smooth and jagged speaker response curve.

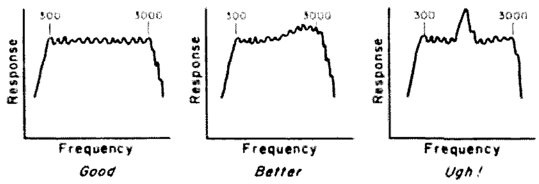


FIGURE 6

Comparison of response curves within voice range

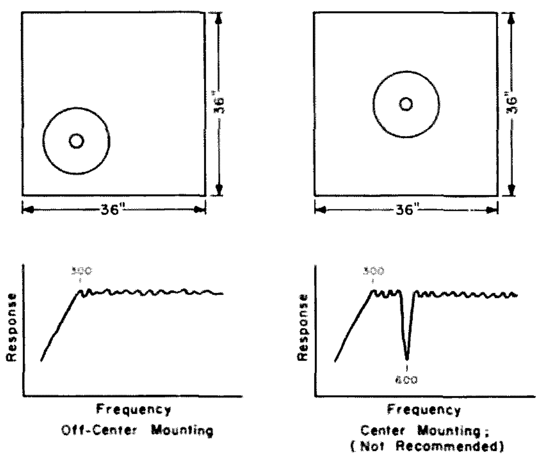


FIGURE 7

Speaker mounting on a flat baffle board.

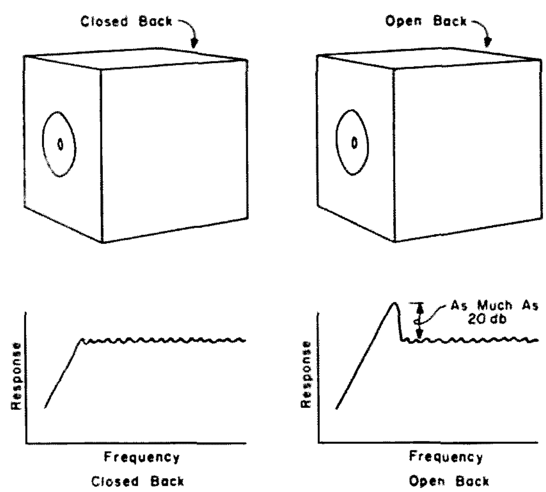


FIGURE 8

Speaker mounting in a wholly-enclosed box.

radio parts distributors, you'll find there are three classes of speakers. First, you have the cheap replacement-type speakers. These you don't want; they just don't have what it takes to do the job in today's amateur phone bands. And at the other extreme, you next have the plush hi-fi jobs. These you don't want, either; they're built for a different kind of application, and besides, they cost too much.

Then lastly you'll find the husky, work-horse speakers designed for use in PA systems. That's what to look for. These speakers generally have good transient and frequency response, are more linear than the replacement-type units, and are reasonably priced. They're built to deliver the goods, not for an appeal to bottom price, or for the snob appeal of a fancy layout. An 8" cone-type speaker built for public-address use (6" or 10" optional), with as much magnet and power rating as you can get, is probably your best buy.

Now that you have brought your speaker, or have decided that the one you have is husky enough—what then? You have to put it somewhere. This calls for an enclosure or some other kind of mounting procedure for the speaker.

There are two best ways to handle this; the difference between them is largely a matter of preference. One way is to mount the speaker on a flat baffle, about 36" on a side, with the speaker midway between the center and one corner. (If you mount it in the middle, you'll have a hole in the response about 600 cycles.)

With this flat baffle mounting, the response of the speaker-and-baffle combination will drop off at 6 db per octave, below 300 cycles. Make it 24" on a side if you wish; then the response will drop off in the same way below 450 cycles.

The other way to mount the speaker is inside a wholly enclosed box of some sort, just big enough to hold the speaker comfortably. Wood is best; avoid metal because of wall resonance which can contribute some vicious resonances to the response. This construction is more work, but it gives a sharper cutoff than the baffle, at the rate of 12 db/octave. The low-end cutoff frequency depends on the size of the speaker and the box; it will be suitable for amateur phone work with almost any 6", 8", or 10" speaker. Be certain not to use an open-back box; this will give you a resonant peak which can be as much as 20 db high, just where it will do you the least good.

Now that you have your speaker successfully in place on a baffle board, or in a wholly enclosed box, you have to put it somewhere—you just can't stand there and hold it. The mathematics of the thing says that the best location is a three-way corner—like the corner formed by two walls and the bench top, for example, or two walls and the ceiling, or two walls and the floor. In this way, the speaker will radiate its acoustic energy into an octant of space (one-eighth of free-space radiation). This gives eight times as much acoustic loading on the speaker cone, plus the horn effect of the three-way corner. This all will have a healthy effect on the transient and frequency

response, as well as on the linearity.

This allows a particularly convenient and efficient variation, which combines the best features of baffle-board mounting and of enclosed-box mounting. That is to mount the speaker in the middle of a triangular wood baffle, which is then fastened tightly between two walls and the bench top. Resulting characteristics are even better than those of the wholly-enclosed box, is easier to build, and takes up less space.

Even though there may be some mathematically "best spots" for the speaker, the practical amateur will want to put it where it is the most convenient, and the XYL (if she is allowed in the shack, and she shouldn't) will want to put it where it is the prettiest. Obviously—especially where women are concerned—there is no one best answer; old fashioned try-it-and-see is still the best approach.

Don't forget, though, that most of us older hams have a high-frequency hearing loss which starts to be measurable in the late 20's. A good idea here is to think about aiming the speaker right at the operating position, to get the highs on a direct beam. Too many highs can be tuned down with a ton control, or by aiming the speaker somewhere else, while if the speaker placement doesn't let the highs come through, this can make all the difference between getting the call the first time, and asking for a repeat.

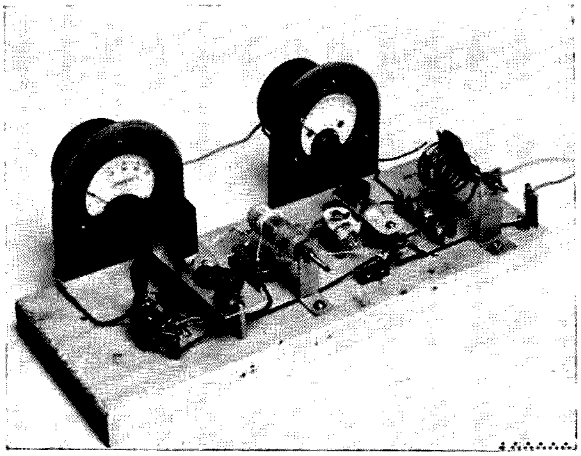
. . . W1JKZ

Polaroid Print Coater Protects Panel Engraving

The Print Coater brush that comes with every roll of Polaroid film provides a handy means of protecting surfaces against wear, abrasion and fading.

A typical use for the Print Coater in the electronics lab or model shop is varnishing instrument panel engravings. Any polished surface will retain its lustre and resist tarnishing indefinitely after an application with the Print Coater. The great convenience of the Coater lies in the fact that the brush requires no dipping or cleaning, does not harden, and comes in its own container.

. . . W2WYM



Photograph of Experimental Transmitter. The oscillator is on the left and the amplifier on the right. The "large" diameter plate tank coil was used to facilitate experimentation.

2 Watt 7 MC Transistor CW Transmitter

Howard Lawrence W2RHD
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Cherry Hill, N. J.

A transistorized transmitter has many advantages over a tube transmitter when battery operated portable use is contemplated. The advantages are especially great when cw operation is desired. Unlike a tube transmitter, the transistorized version draws no current from the battery when the key is not down: the transmitting key itself turns everything on and off in the transmitter that draws power.

The transmitter to be described was designed for portable operation, using a small 45 volt "B" battery with a 22½ volt tap for tuning. One anticipated application requires installation in a small cruising sailboat which does not have an engine, and therefore no generator to charge batteries. Coupled with a transistorized communications receiver, long operating time from a small battery will be possible.

The schematic of the transmitter is shown in Fig. 1. A breadboard transmitter employing this circuit is shown in Fig. 2. This transmitter uses two 2N697 silicon transistors, one as an oscillator and one as an rf amplifier. The price

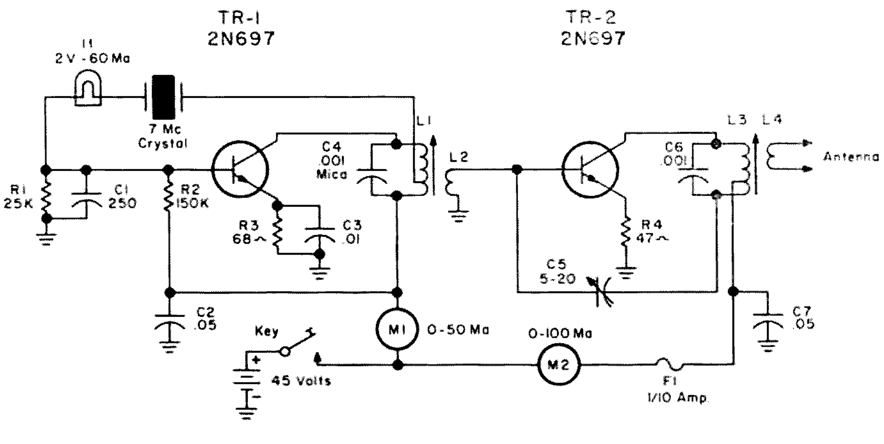


FIGURE 1

Schematic of Two Watt 7 Megacycle CW Transistor Transmitter.

of this transistor is now about $2.00, making it economically feasible for amateur use. It is rugged and will handle a fair amount of short time overloading.

A Pierce oscillator circuit is employed with the crystal feeding energy from the collector resonant circuit, LI and C4, to the base of the oscillator transistor, TR-1. 1-1 is a two-volt 60 ma pilot light (pink bead) used to monitor crystal current. This light is very handy for tune-up and once the operator becomes familiar with its indications, the current meter 1-1 can be eliminated. The oscillator transistor is run well below ratings and therefore can operate continuously. The resonant circuit is interesting because it is designed to have a low impedance to match into the 2N697 collector circuit. C-4 is a 1,000 pf mica capacitor and the tuning inductance L-1 looks more like one used at 50 megacycles than one used at 7 megacycles. L-1 is seven turns of number 22 wire on a ½ inch form, the coil winding being ½ inch long. It is iron core tuned. The crystal is tapped on this coil at its center.

The power amplifier, TR-2, is another 2N697 biased past collector current cut-off. It draws no current when not being driven by the oscillator. The coupling coil to the amplifier, L-2, is two turns close-wound over the cold end of L-1.

It is necessary to neutralize the amplifier to prevent the whole system from running away when not properly tuned. Such a run-away can damage the transistors. C-5 is a small ceramic trimmer capacitor used for neutralization. The tap on L-3 is adjusted as part of the neutralizing procedure. It is important that the fuse, F-1, 1/10 ampere, be included to prevent loss of the power amplifier transistor due to severe mistuning or oscillation which may occur before the transmitter is neutralized.

A large 1" diameter amplifier collector output coil was used to facilitate experimentation. The collector circuit is fine-tuned with a ½" diameter powered iron core after the circuit has been roughly tuned by adjusting the length of the coil. The output stage is coupled to the antenna by a 6-turn close wound coil of insulated wire.

In the photograph, the oscillator is on the left and the rf amplifier on the right. A 4-terminal strip carries all of the resistors and capacitors associated with the oscillator except for the output tank capacitor, C-4. Heat sinks are used on the transistors. The neutralizing capacitor is mounted next to the amplifier transistor. The fuse for the final amplifier is mounted below the meter, behind the mounting bracket.

Adjustment Procedure

Oscillator adjustment should be made with a 22 volt supply. No voltage should be applied to the amplifier but the amplifier transistor should be in its socket. The crystal oscillator is tuned by adjusting the core in L-1 until oscillation starts. Oscillation is determined either by a drop in the reading of meter M-1 or by listening to the oscillator on a receiver. The pilot light, 1-1, may glow dimly. The transistor will draw about 8 ma at 22.5 volts when oscillating properly. When the battery voltage is increased to 45 volts current (M-1) will be about 16 ma. The variation in the oscillator collector current as the resonant circuit is tuned is the same as the variation of a tube crystal oscillator plate current.

The rf amplifier stage is next adjusted. Connect the tap on L-3 to the center of the coil and set the neutralizing capacitor C-5 at mid value. If a grid dip meter is available, the output circuit can be resonated before power is applied, after first calibrating the grid dip meter against the transmitter oscillator. With 22.5 volts on both oscillator adn amplifier and no antenna or other load connected, adjust the core in L-3 to obtain a dip on meter M-2. M-2 will read about 20 ma. Be sure the 1/10 ampere fuse is in the circuit; it may save a transistor.

Neutralization is most easily accomplished with 22.5 volts applied to both oscillator and amplifier. Set the oscillator core so I-1 glows dimly. Tune the output circuit in one direction (screw core into coil, for example) and note effect on I-1. Return core to original position. If 1-1 increases or decreases in brightness, change adjustment of C-5 and recheck effect of screwing core into coil. When the amplifier is neutralized the brightness of I-1 will not change when L-3 is tuned. If neutralization can not be obtained, move the coil tap one turn toward the end of L-3 connected to C-5 and repeat the above process.

Antenna Coupling

Inductive coupling to the antenna is most convenient to use. The size of the coupling coil will depend on the particular antenna to be matched. To feed a half-wave dipole at its center a 6-turn random close wound coil of number 22 insulated wire 1¼ inches in diameter was used as a coupling coil. Series tuning was used. A grid dip meter set at the transmitter frequency can be used to make initial antenna adjustments. The antenna coupling coil is loosely coupled to the grid dip meter coil and the antenna tuning capacitor(s) adjusted until resonance is indicated.

Initial adjustment with the transmitter is made in a similar manner, very loose coupling being used until the antenna is resonated, after which coupling is increased. Care should be taken not to couple so tightly that the transmitter is overloaded. Since impedances and voltages are low, the antenna coupling coil can be pushed between turns of L-3. Insertion about half-way into L-3 will give proper coupling. When properly tuned and loaded, the amplifier current will be 60 to 70 ma at 45 volts. The crystal current indicator, I-1, will show a dim but white color.

The measured output power on the model ran about 1.5 watts with slightly under 3 watts input, giving an efficiency of better than 50%. It should be remembered that the output transistor can be run at this power level only intermittently (cw) without overheating. Care must be taken not to hold the key down for long periods with full plate voltage applied.

Single Transistor Transmitter

If desired, the crystal oscillator can be operated directly into an antenna with a few minor modifications. The bias on the base of TR-1 is raised by changing R-2 from 150K to 50K. For convenience, the large plate tank coil, L-3, is used with the oscillator instead of L-1. The tap for the crystal is made to the center turn. A 1/10 ampere or smaller fuse should be used in the battery lead for protection. Over-coupling to the antenna will cause the oscillator to chirp or even stop. The model tested gave an output power of 1/3 watt with 0.9 watts input for an efficiency of 38%. A 45 volt supply was used. Current drain (M-1) was 20 ma. Under these conditions the oscillator transistor must be operated intermittently.

Parts List

R-1—25K ohms, ½ watt
R-2—150K ohms, ½ watt (50K if amplifier is not used)
R-3—68 ohms, ½ watt
R-4—47 ohms, ½ watt
C-1—250 pf, 100 volt mica or ceramic
C-2—0.05 mf, 100 volt ceramic or paper
C-3—0.01 mf, 100 volt ceramic or paper
C-4—0.001 mf, 100 volt mica
C-5—5 - 20 pf, ceramic or air trimmer
C-6—0.001 mf, 100 volt mica
C-7—0.05 mf, 100 volt ceramic or paper
L-1—7 turns #22 wire, ½ inch long on ½ inch iron core tuned form
L-2—2 turns #22 insulated wire close-wound over cold end of L-1
L-3—5 turns #14 wire, 1 inch diameter, 1 inch long, air wound
L-4—6 turns #22 insulated wire random close-wound (see text)
TR-1, TR-2—type 2N697 transistors
I-1—2 volt 60 ma, pilot light (pink bead)
F-1—1/10 ampere fuse

Quieting Small Cooling Fans

In many small and medium-sized amateur installations, localized heating is a serious problem. Standard remedy for this is the installation of a small cooling fan, usually drawing less than 100 watts. This drives a blast of cooler air into the "hot spot", lowering the temperature appreciably.

The cooling fan is usually mounted on a bracket, firmly bolted to some part of the assembly. As this is usually of thin metal, the fan vibration is communicated to the rest of the chassis, which acts like a resonator, so that the noise power output of the fan seemingly exceeds its "blow power".

This noise nuisance can usually be abated by mounting the fan on a massive bracket—as massive as possible—and by attaching that bracket to the chassis by means of shock mounts. A sample mounting of this type is shown in Fig. 1. This procedure lowers the natural period of vibration of the fan assembly; and then prevents most or all of this vibration from reaching the chassis. In happy consequence, there is less or no noise output—a bass drum is silent if you don't bang on it.

Noise can be reduced further if the fan

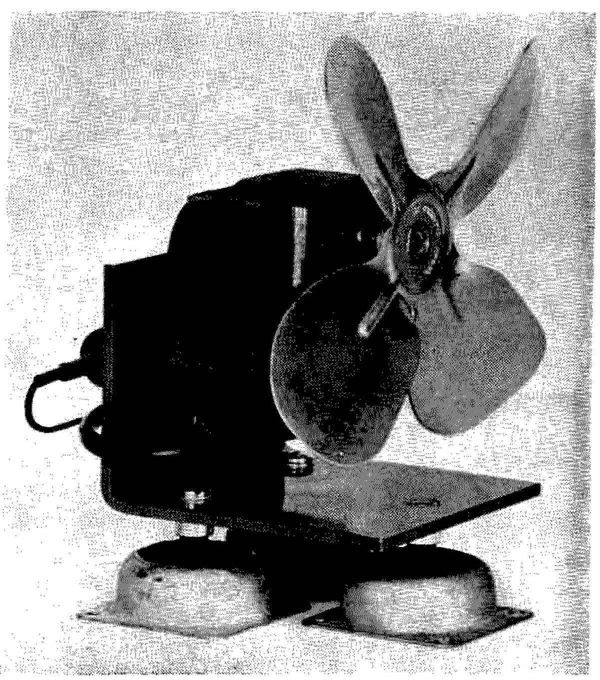


Fig. 1: Noise-reducing fan mount

blades are trued up; and very high-pitched fan noise can be minimized by carefully rounding the edges of the fan blades with emery cloth.

Fan mount stability is desirable to prevent slow oscillation of the assembly. This calls for at least a three-point mounting. Four shock mounts may be used if desired, but additional mounts, beyond three, bring about little improvement of stability.

A Few Unusual Receiver Circuits

Henry Cross W1OOP

In the last receiver I made, which was a "converter if" tuning 14 to 18 mc/s, most of the circuit was pretty ordinary. There were a couple of features which may not be novel, but are not found in the usual handbooks.

1. Input attenuator. Using a cheap 2-pole 3 position switch (Centralab 1473) we get 0-6-12 db attenuation in a 50 ohm circuit. Handy for avoiding overload situations, also gives a quick check on the S-meter.

2. Noise limiter. The circuit shown is critical as to diode type, but can be used in receivers like the rax and auto radios where other noise limiters are too hard to put in. It also works on ssb, even without a product detector. Recommended diodes are silicon computer types rated for very low capacitance and ultra-fast recovery, such as the MA-4244 or MA-4441 (for hybrid auto radio or transistor circuits, the Microwave Associates type 1N903 or IN904 will be satisfactoy), Fairchild 1N916a, Transitron SG 5000, etc. The action is to clip short pulses (ignition noise pulses have a length roughly the reciprocal of the if bandwidth, ie, about 500 microseconds for many modern communications receivers more like 200 microsec for auto radios) while following the envelope of the signal at voice frequencies. To turn off the limiter, open at point x.

3. AGC delay using silicon diode. The circuit shown uses a 1N64 as detector, and the slight positive bias on the AGC bus actually

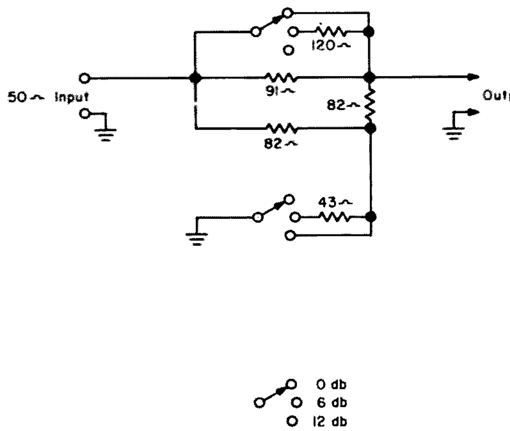


FIGURE 1

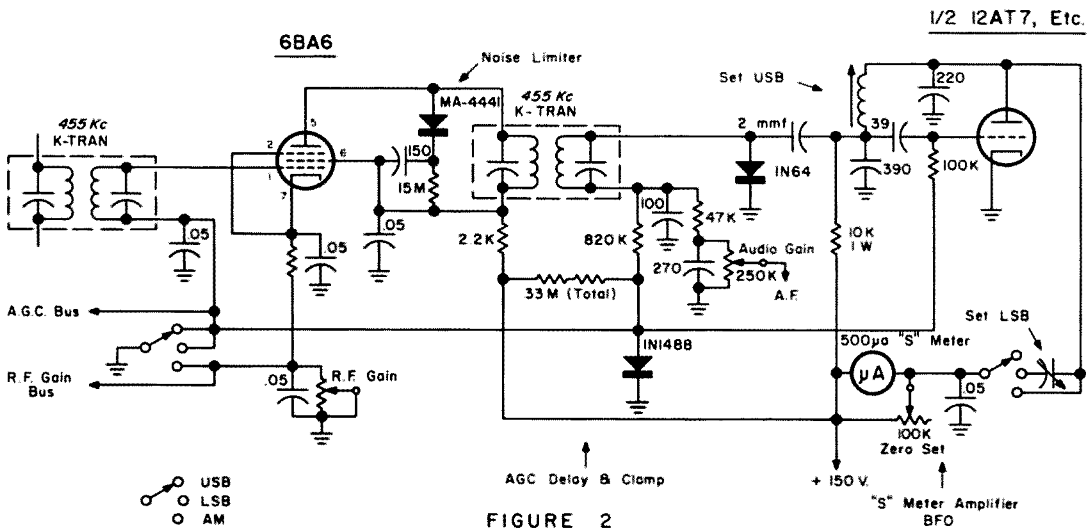
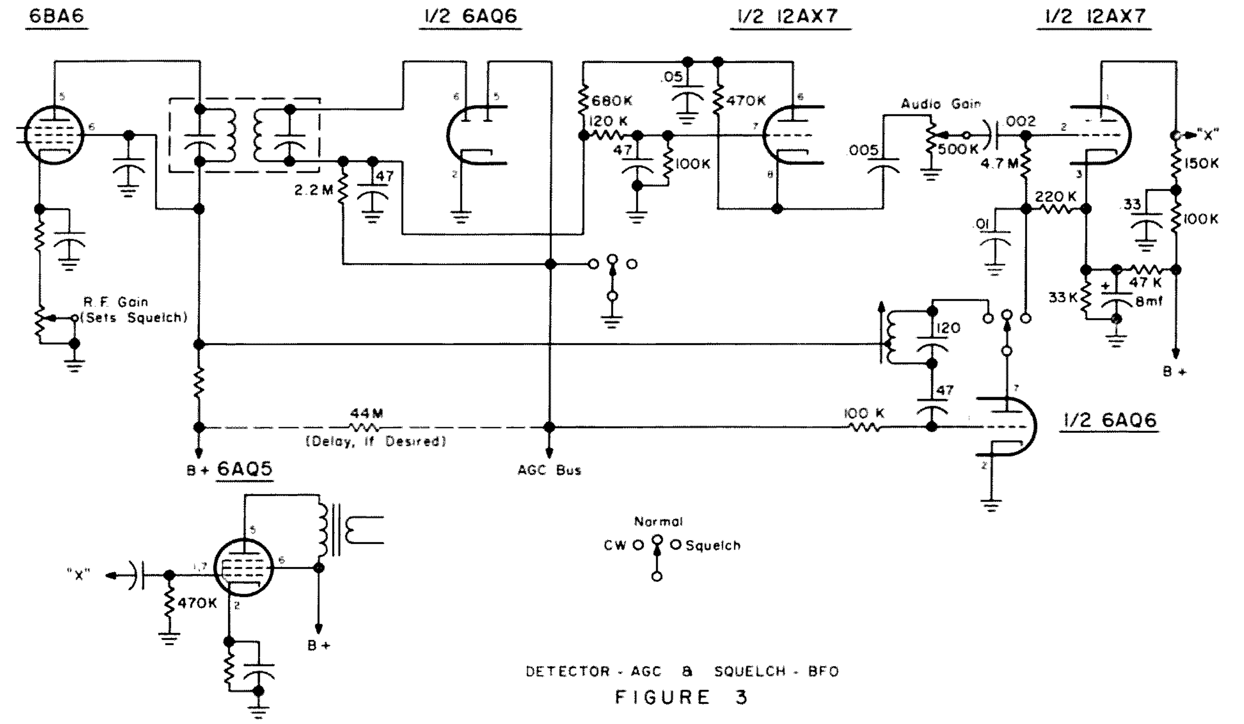


FIGURE 2

helps detection. The advantage of this circuit is that the amount of AGC delay can be easily adjusted without the detector having to be "off of ground". Any good silicon junction diode will do the job—1N1490, 1N457, 1N629, 1N903 all work. The AGC bus will be about ½ volt positive with no signal, which is all to the good.

4. Bfo and S-meter. Economy demand that all tubes stay busy during all types of reception. Fig. 2 shows the noise limiter, detector, agc, s-meter and bfo circuits. The bfo has no pitch



DETECTOR - AGC & SQUELCH - BFO
FIGURE 3

control, merely preset frequencies at the two edges of the pass band for upper band lower sideband reception. In the phone position, the bfo is stopped by putting an RF ground on its plate, and a backward-reading type S meter is hooked in the circuit. I used a 500 microamp surplus unit.

Another double-duty arrangement is shown in Fig. 3, where a 6AV6 or 6AQ6 is used as detector, agc clamp, bfo and squelch. A dpdt center-off toggle switch may be used here, giving Squelch, Normal, and CW. I suppose the tube could run an s meter in the normal position, but as I never tried it I will not describe it.

. . . W1OOP

A Long Look at Test Equipment

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"Who, me?" do we hear you asking? "What do I want to know about test equipment for? I don't have any."

Which may, sadly enough, be so. But nobody yet ever put a transmitter on the air without at least a rudimentary amount of test equipment (even if it was nothing more than the built-in meter or lamp-bulb substitutes), so every ham should know a little about the subject. And if you're a homebrew addict, then you already know the value of test equipment in chasing out bugs from a circuit.

But the page on top of page in every catalog of test equipment often makes the decision of which items to start with a difficult one. So here we'll look first at the most essential measurements, the types of test gear which can make these measurements, and the directions in which you might want to expand the test facilities once the essentials are accomodated. And before we're through, we'll present a suggested schedule of test gear which winds up as a completely equipped lab, in easy stages. Interested? Read on:

In building your equipment, the most essential measurements will be those of voltage and current in dc circuits, and voltage, current, and frequency in ac hookups. Running very closely behind these in order of importance will be measurements of circuit constants such as resistance, capacitance, and inductance.

Voltage, current, and resistance can be measured by the gadget know as a VOM (for volt-ohm-milliammeter); voltage and resistance can be measured with the VTVM (vacuum-tube voltmeter); and voltage itself can be measured with an oscilloscope. All these instruments are capable of measuring either ac or dc, although to measure dc with an inexpensive scope takes some special technique. With some easily-rigged adapters, the VTVM or the scope can be used to measure current, and the scope can measure resistance. Thus any one of the three instruments is capable of handling four of the five most essential measurements, and resistance as well.

Frequency can be measured with a frequency meter, with a grid-dip oscillator, or with a receiver (don't laugh—a good receiver is one of the most useful items of test equipment you can have).

Since the VTVM can, with another external adapter, measure capacitance, and since any of three other instruments will measure frequency, you can then measure (indirectly) inductance. And all eight quantities can be measured.

Thus the combination of a voltage-measuring device and a frequency-measuring gadget can take care of all esential measurement requirements—but is this enough? Not if you do much building!

For instance, you may want to measure the

OBJECTIVES OF THE INSTITUTE OF AMATEUR RADIO

1. Establish an office in Washington, D. C. with a full time representative to keep in contact with Congress, the Administration and all government officials in any way involved with amateur radio matters.

2. Supply Congress, the FCC, government officials and news services with news releases on amateur public service, and other achievements.

3. Compile a list of the officials of foreign governments who are involved with amateur radio or who are good possibilities as delegates to the coming Geneva conference and provide a steady stream of information to them about the values of having a strong amateur service, the accomplishments of amateurs everywhere, and news of important changes in amateur regulations world-wide.

4. Send representatives to visit foreign officials and do everything possible to see that amateur radio is understood and appreciated world-wide. Help newer and underdeveloped countries to establish a strong amateur service in every way possible.

5. Provide funds to help fight important court battles in our own country which could set a precident which would be harmful to amateur radio.

6. Set up a program of technical achievement with certificates and awards.

7. Establish a country-wide organization to provide an exchange of information on current amateur affairs between all government and other interested parties and the amateurs themselves.

8. Work in cooperation with the ARRL and through 73 Magazine to improve operating practices on our bands and to encourage a wider use of our many ham bands.

9. Work in cooperation with the RSGB to remove and discourage foreign commercial and broadcast stations operating in our ham bands against international regulations.

10. Work to strengthen the ARRL and help it in all ways possible to carry on its many beneficial programs.

The Institute of Amateur Radio, a non-profit corporation, with your support, will immediately start working on the programs outlined above. If you have any question about the immediacy of the situation then please take the time to read the articles by Prose Walker in the October QST on page 48 and by Ivan Loucks on page 82 of the December QST.

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impedance of your new antenna. Or the SWR on the feedline. You may have need to check our your modulator, or adjust an audio filter. If you're a sidebander you probably have occasion to check band and pass of a circuit from time to time, and in any event you will someday need to test a tube. So just what will you need?

Let's back off and look at a generous helping of the test gear commercially available for ham use (without regard to brand name or model number), to see just what it is and what it can do. Then we'll look at some unconventional ways to use some of it, and by the time we're through you will probably have a pretty good idea of what you need to fit your own needs.

The VOM

A good starting place is the lowly VOM; these gadgets are available for as little as $4.95, or you can pay up to nearly $100. As in everything else, you get about what you pay for. A good, serviceable instrument can, however, be obtained for from $8 to $15 from most mail-order houses—this is less than it would cost to build for yourself.

The VOM consists of a sensitive current meter; it usually uses a 0-1 milliammeter, or a 0-50 microammeter, although other types are found occasionally. In addition to the meter,

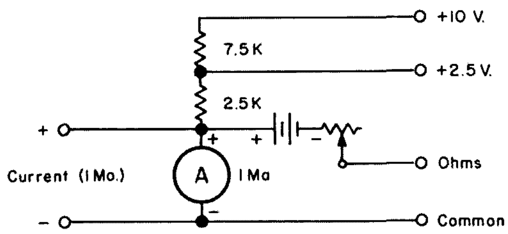


FIGURE 1

Simplified VOM circuit

shunts, and multipliers are provided so that you can measure either voltage or current on several scales. A battery and calibration resistor provide the capability of measuring dc resistance, while a rectifier allows voltage or current readings on ac as well as dc.

VOM's are usually rated in "ohms per volt" with 1,000 ohms/volt, 10,000 ohms/volt, and 20,000 ohms/volt as common ratings. The higher this rating, the more accurately the meter will measure in high-impedance circuits. Also, the more expensive the meter as it must have a more sensitive basic movement.

In addition to the ohms/volt rating, the things to look for in a VOM include the number of scales provided, the ranges of the scales, and the general operating convenience of the instrument.

How can a VOM be used? It's a natural for measuring power-supply voltages, as well as for measuring current to stages not already metered. Its resistance ranges can be used to identify resistors, and also for continuity checking in cables. The VOM has one great advantage over other voltage-measuring devices; it is fully self-contained and as a result is exceptionally portable. Regardless of your other test gear, you should have at least one VOM around!

The Grid-Dip Oscillator

First described in the early 30's, the GDO was one of the "forgotten" instruments of test equipment until resurrected about 1945; now at least a dozen are available commercially, in both tube—and transistor-type varieties.

The GDO is basically a variable frequency oscillator with a grid-current meter; plug-in coils allow it to cover a wide range of frequencies. When the oscillator is running, the meter indicates the amount of grid current. If the oscillator is coupled to a resonant circuit and the oscillator frequency is varied, power will be transferred to the coupled circuit when the oscillator reaches the frequency at which the coupled circuit is resonant. The power coupled out is no longer available to provide grid circuit, so the meter needle dips. This is where the device gets its name.

Most present-day GDO's also incorporate a switch to turn off plate voltage to the oscillator but leave everything else on. In this case, the instrument becomes an indicating wavemeter. The meter needle will not leave zero until rf is coupled into the GDO tank circuit from an external source; when that happens, the rf is rectified in the diode formed by grid and cathode (or base and emitter) of the oscillator, and grid current flows. The amount of grid current indicates roughly the amount of rf, so it can be used as a field- strength meter or rough comparison device.

Provision is also made to plug in a headphone in place of the meter; when the oscillator is on, you can hear a beat note as the oscillator frequency approaches that of an rf source coupled to the tank, and with the oscillator off, you have a rudimentary crystal set usable for phone monitoring.

The normal use of the GDO is to determine the resonant frequency of a tank circuit, either one under construction or in pre-tuning a transmitter before turning on plate voltage. However, with a couple of "standard" units—one a capacitor of accurately known value and the other an inductor of similarly known value—the gadget can measure inductance and capacitance. To measure inductance, connect the standard capacitor to the unknown inductance and use the GDO in normal fashion to find the resonant frequency of the combination. Then solve the resonance equation to determine what inductance resonates at the frequency with that capacitance. The equation, in terms of L, is $L = 25,330/f^2C$, with L in microhenries, C in picofarads, and f in megacycles.

To find capacitance, follow the same procedure. The formula then becomes $C = 25,330/f^2L$, in the same units as before.

In the indicating-wavemeter mode, the GDO is a good neutralization indicator for a trans-

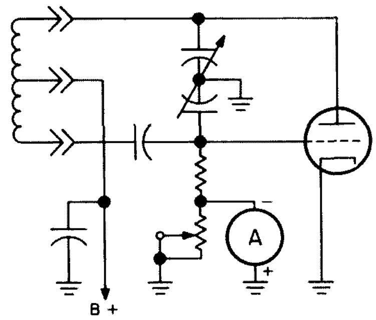


FIGURE 2
GDO Typical circuit

mitter tune-up. Couple the GDO to the final tank and remove plate and screen voltage from the final. Tune all preceding stages for maximum grid current in the final and maximum indication on the GDO. Adjust neutralization for minimum reading on the GDO while retaining maximum final grid current (retune the final grid circuit each time to maximum grid current). When the GDO indication reaches zero, you're neutralized. Remove GDO and hook up plate and screen voltages.

The Receiver

Uses of a receiver as an item of test equipment are many. One of the most common is to check that an oscillator is operating properly. If the oscillator output produces a clean, clear note when received with the BFO on, and shows no tendency to jump frequency, you can assume that it's working right.

But the receiver as a test instrument is not limited to checking oscillators. For instance, a general-coverage receiver can be used for the same purpose as a GDO in finding the resonance point of a tank circuit, if the tank can be connected in series with the antenna lead. A parallel-resonant circuit has high impedance at its resonant frequency, and so if it is inserted in the antenna lead signals or external noise will be greatly reduced at this frequency and no other.

When turned to WWV, the receiver produces a source of audio tones to known frequency, as well as being an aid to calibration of frequency standards.

In adjusting a SSB rig, a receiver equipped with an S-meter becomes an exceptionally sensitive rf VTVM, alloing comparison of levels of wanted and unwanted sidebands, as well as providing a good indicator of carrier balance. And when neutralizing any transmitter, the receiver can be used instead of the GDO as the output indicator for a much more sensitive indication.

Of course, there's no need to say "Buy a receiver" because almost everyone has one. But for test-equipment usuage, important points include general coverage and S-meter indications. Many hams have found it worthwhile to add a second inexpensive receiver of this sort to their stations for testing purposes, to back up their more specialized ham-bands-only communications jobs!

The Vacuum-Tube Voltmeter

VTVM's come in three basic categories: most common is the "general-purpose" type,

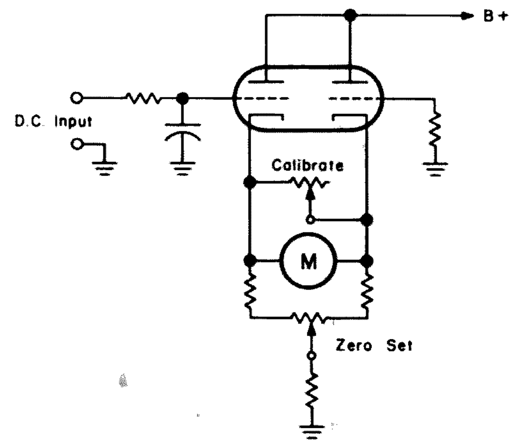


FIGURE 3
VTVM bridge circuit

which is also the most useful for ham purposes. The other types are the "AC VTVM", used for measuring very small ac voltages, and the Digital Volt meter or DVM which is as useful as a general-purpose job, more accurate to boot, but costs upwards of several thousand dollars!

The general-purpose VTVM usually contains two or three tubes; it consists basically of a balanced-bridge dc amplifier with a sensitive meter movement to indicate the degree of unbalance. With no input, the bridge is balanced and the meter reads zero. With dc input to the bridge, unbalance results and the meter indication shows the amount of dc applied. The other tubes act as rectifiers for ac signals and for power-supply purposes.

Major advantage of the VTVM over the VOM is that the VTVM is a voltage-operated device with exceptionally high input impedance. The VOM, on the other hand, is a current-operated device with lower input impedance. The high input impedance of the VTVM means it loads the circuit being measured much less, and readings are more accurate. It also allows a wider range of resistance measurements to be made. Typical circuits of VTVM bridges and ohmmeter sections appear in Figs. 3 and 4.

However, to measure current with a VTVM we must proceed indirectly by putting a resistor in series with the circuit and measuring the voltage drop across the resistor. If the resistor is 1000 ohms, every ma of current through it will produce 1 volt across it; thus the voltage reading tells us the current. The VOM can measure current directly.

The high input inpedance of the VTVM allows its use for many measurements which cannot be made with the VOM. For instance, both capacitance and large values of inductance can be measured by the VTVM, by connecting the capacitor or inductor in series with an adjustable resistor as shown in Fig. 5 and applying ac of know frequency (60-cycle from the power line is usually used) across the series pair. Adjust the resistor's value until the VTVM indicates the same amount of voltage across the resistor and across the capacitor or inductor; then remove the ac and measure the resistance of the resistor. This will be equal to the reactance of the capacitor or inductor at the chosen frequency, and the value in microfarads or henries can then be calculated from the reactance formula. For 60 cycle ac, capacitance will be equal to $2720/X_c$, where $X_c = R$ in ohms and capacitance is in microfarads. Inductance will be equal to $0.000272X_1$, where $X_1 = R$ in ohms and inductance is in henries.

Another method of measuring capacitance with a VTVM, first described by John Janning, W8QCN, in the August 1959 issue of Radio-

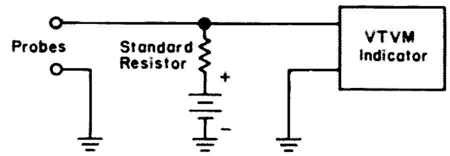


FIGURE 4
VTVM ohmmeter circuit

Electronics magazine, makes use of the circuit shown in Fig. 6. This is a rectifier which produces pulsating dc, and the average dc level available at the output is directly proportional to the amount of capacitance in the filter. Thus the scale of the VTVM can be calibrated to indicate capacitance when measuring the voltage at the output. For full details, see the original article.

In conjunction with a good rf choke at the tip of the probe, a VTVM can be used to measure grid bias on an operating rf stage. This helps both in tuneup of a transmitter or in adjusting the value of the grid-leak during an experimental design.

VTVM's are available from a number of manufacturers; prices range from about $25 up, depending on the number of features included, whether you get a kit or a factory-wired instrument, etc.

The Oscilloscope

Not so awfully many years ago the oscillo-

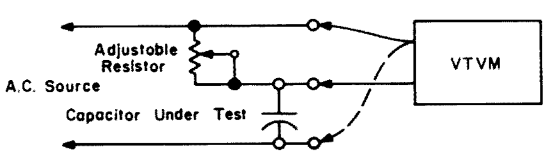


FIGURE 5
Capacitance measurement with VTVM

scope was strictly a laboratory instrument; television changed all that in the years after 1945, so that today a good scope can be purchased for as little as $50.

The purpose of the scope is to present a visual image of what goes on in a circuit; this may seem to be a rather limited purpose, but it is actually exceptionally broad in its implications.

The scope is possibly the most versatile item of test equipment in existence; it may be used equally well for checking transmitters, receivers, audio circuits, rf stages, power supplies, or any other combination of electronic components. It is the only type of measuring instrument which shows directly and visually just what is happening at the point to which it is connected, and is the only instrument capable of making accurate measurements of complex ac waveforms.

The key component of the scope is the cathode-ray tube; this is a special tube having an "electron gun" which focuses electrons leaving the cathode into a straight, tight beam, two or more pairs of deflection plates which enable the beam to be moved to any position, and a fluorescent screen at the far end where the electron beam is made visible. Any device incorporating a cathode-ray tube of this general description is an oscilloscope—but most scopes have additional components to enable wider uses of them.

Most essential of these additional components are the horizontal and vertical amplifiers. The deflection plates of the CRT require quite high voltages to achieve adequate deflection of the electron beam, and these amplifiers raise small input voltages to the levels required by the CRT.

The characteristics of the vertical amplifier usually determine the scope's performance characteristics; this amplifier may be either of the ac variety like most audio amplifiers, or direct coupled so that dc inputs will result in spot deflection. The frequency limits of this amplifier may be either narrow, as in most audio amplifiers, or wide, as in a video amplifier. Most common TV-service scopes have vertical amplifiers rated from about 5 to 10 cps at the low end up to about 500 kc at the top; "color-TV" scopes go on up to about 4 mc at

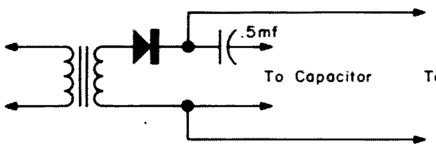


FIGURE 6
WBQCN measurement technique

the top, while the more expensive laboratory instruments go, in some cases, higher than 50 mc.

The horizontal amplifier is less critical; so long as it reproduces the sweep waveform properly it his little effect on scope operation. Some scopes have identical vertical and horizontal amplifiers, but most have restricted bandpass in the horizontal circuit.

For general-purpose usage, another important component of the scope is the "time-base" or horizontal sweep generater. This is a circuit which moves the electron beam across the scope tube face at a constant rate of speed; the exact speed at which the beam moves is determined by the sweep-frequency settings on the scope control panel, and usually ranges from a low of about 60 inches per second up to about 2,000,000 inches per second (15 cps and 500 kc, respectively, on a 5-inch screen).

Normal use of the scope in most ham shacks is to check on the waveshape of ac voltages; for this purpose the vertical input is connected to the point at which the voltage to be viewed is present and the horizontal sweep controls are set for a convenient, stationary display. Vertical and horizontal amplifier gain controls are set for a display of convenient size, and brightness and focus are set for a comfortable light level on the screen. Then by watching the displayed waveform as various adjustments are tried, the effect of each adjustment on the circuit under test can be determined immediately.

Another widespread use of the scope is to check modulation. To do this, some of the modulated rf output is coupled directly to the vertical deflection plates of the CRT; a two-turn link usually will pick up enough from the final tank to get a good display. Setting the horizontal sweep controls to a convenient sweep rate will give a wave-envelope display, so that you can easily see if any distortion or overmodulation is present. Connecting the horizontal input of the scope to the output side of the modulator will give a triangular or trapezoid display, which is actually a graph of the modulation linearity of the stage. The object is a triangle with perfectly straight sides. Details of this display have been described elsewhere so many times they won't be gone into here.

But the scope can also be used as a voltmeter; a dc scope works for both dc and ac voltages, while an ac scope checks only ac unless an adapter of some sort is added. Start with a known source of voltage and adjust the vertical gain controls for a convenient number of squares height of the display; any trace with the same height will have the same voltage level, if the gain controls are not disturbed. To read current with a scope, or to take a current waveform, follow the same technique described for the VTVM earlier.

To measure inductance or capacitance, you can use the same technique described for the VTVM but it becomes even simpler. Connect the junction between capacitor and resistor to the ground point of the scope, then connect the other end of the capacitor to the vertical input and of the resistor to the horizontal input. Set the vertical and horizontal gain controls for identical gain through each amplifier (this will not necessarily be identical settings of the controls themselves) and then vary the resistor, with ac applied across the pair, until the screen pattern has equal width and height. The pattern will usually be an ellipse, but may at times resemble a straight line inclined at 45 degrees. At this point, the voltage across resistor and capacitor are equal, and the resistance value can be measured and used in the reactance formula to determine capacitance.

Unlike most other test instruments, the scope's unlimited versatility makes a complete description of its uses too long to include here. Even the John F. Rider "Encyclopedia on Cathode-Ray Oscilloscopes and Their Uses," measuring 998 9x12-inch pages packed with print, fails to include *all* the uses of the scope.

Prices of present day scopes range from about $66 for 3-inch (screen size) kit up into the thousands of dollars for Tektronix laboratory instruments; for general ham use, a relatively inexpensive dc-coupled unit is advisable. It should cost about $70 in kit form or $110 factory-wired.

Antenna Impedance Meter

An interesting item of ham test equipment is the antenna impedance meter or antennascope, which measures rf resistance of antennas and feedlines. For the antenna experimenter, one of these devices is almost a necessity. They measure resistive impedance from near zero to greater than 100 ohms, allowing proper design of matching networks to insure perfect antenna-feedline matches.

The basic instrument consists of an rf bridge with a variable "standard" arm; with the antenna or feedline connected as the "unknown" leg of the bridge and a small amount of rf energy of the proper frequency fed into the bridge, the "standard" leg is varied until a null is indicated. The amount of resistance in the "standard" leg is then equal to the rf resistance of the antenna.

While designed primarily to measure rf resistance, the device can also be used as an SWR bridge by simply setting the "standard"

leg to the desired feedline impedance and seeing if a null is achieved. Machining adjustments can then be varied until a null is indicated. However, this instrument will not give a direct or an accurate indication of the amount of SWR, if no match is achieved.

SWR Meters

An approximately accurate determination of the amount of SWR can be achieved only with an SWR meter, which measures both the outgoing power and that reflected back which creates standing waves, then compares them to determine the SWR.

Three basic types of these meters exist. One measures power going up and power coming back, leaving the calculation up to you, while the other types measure voltage out and voltage back, and usually give direct readings of SWR. At high SWR values, the power variety proves more accurate, but below an SWR value of 2 to 1, the voltage-reading type provides a more expanded, hence more accurate, indication.

An older type of SWR meter is the bridge, operating similarly to the Antenna Impedance Bridge just described but with a fixed "standard" leg. This type has been almost completely superceded by the newer types, since the newer models can remain in the feedline at all times to be used as power indicators during tune-up or operation.

With the voltage-reading types of SWR meters (typical price, about $30 to $50), you simply switch the meter to "forward" and adjust the knob for a full-scale meter reading, then switch back to "reflected" and read the SWP from the meter face. For a more perfect match, once you have SWR down so low the meter deflection is almost unnoticeable, you can crank the knob all the way open and simply adjust for a null on the meaer. The readings won't be accurate in value when you do this, but since under normal reading conditions you can easily measure SWR as low as 1.05 to 1, you will know that final SWR is lower than that.

No SWR bridge can be accurate when used at the transmitter end of a long run of lossy feedline, since the reflected voltage or power which is the basis of its measurement will be reduced by the feedline loss. For most accurate results, especially in initial tuning, the meter should be placed directly at the antenna terminals. Afterward, of course, it can be placed at the transmitter for a running check on tuning of the rig.

Field-Strength Meters

A common item of ham test equipment is the field-strength meter, or FSM. This is simply an indicating wavemeter, fitted with a short pickup antenna, to indicate the relative amount of rf floating around wherever the FSM happens to be located.

Major use of the FSM is to indicate proper tuning of a transmitter or to indicate antenna output. Many of these devices are sold and used, but either a GDO in the wavemeter mode or one of the newer types of SWR meters will do the same job—and several others as well. One major advantage the FSM has is that it is usually completely portable, requiring no source of power. However, its restricted usefulness tends to cancel this advantage out.

Audio Generators

If you're a CW man, you can skip this section. But if you operate any type of fone station, either am, fm, or sideband you will need an audio signal generator at some time or another. The generally used whistle is nowhere near the best way to determine how well an audio section is working—for one thing, it's hard to keep exactly the same volume for a half hour without a pause!

Almost as many kinds of audio signal generators—or oscillators, if you prefer that name—are around as you can imagine. Most of them, fortunately, bear fairly low prices because of the hi-fi boom. All you have to have is something which will produce sine waves at two or three spot frequencies, such as for instance 300 cps, 1500 cps, and 3000 cps. The upper and lower frequencies allow you to check performance at the limits of the generally accepted speech band, while the 1500 cps is a convenient value for general trouble-shooting.

But a hi-fi type of generator, covering 20 cps to 20 kc or so, is just as inexpensive and can make life much simpler. With one of these, you can check your audio shaping circuits accurately, and find out just how many db down you are at 9700 cps, etc.

Some of the more versatile commercial audio generators contain provisions to supply either sine-wave output, or square waves. The average ham experimenter will almost never have need of square waves, but if the provisions come at no exetra cost you might as well have it. For one thing, a square-wave generator can be set to 100 kc and a high-order harmonic of this zero-beat with WWV to give you a good, accurate (for short periods of time) frequency standard. Just remember that a square-wave contains odd harmonics only; the second, fourth, sixth, etc., will be absent.

Prices for this item range from about $30 on up. Look for one with wide frequency range and some sort of output calibration so you can easily get the output level you want.

Many use only a simple pot in the output, and this can be horribly confusing at times.

Sweep Generator

The sweep generator produces a frequency-modulated rf signal, which can be used to adjust the bandpass of if strips, converter output circuits, transmitter interstage networks, etc. While it is designed for TV service work, it's also mighty handy in the ham shack.

Most sweep generators use a hetrodyne technique, in which the swept generator operates at a fixed frequency region and its FM output is mixed with that of a non-swept VFO; most of them have output in the TV and FM bands only, but many come down as low as 10 mc.

Sweep widths are usually continuously adjustable from zero to 10 mc. For ham use, about 5 mc is the maximum sweep usually needed. More often, you'll be using only a few kc of sweep.

The sweep generator can be used only with a scope, and the two together provide you a picture of the passband of the item under test. Sweep generator output is connected to the item, and the rf passing through the item is detected by an rf probe and displayed on the scope. It's the fastest method know for adjusting a bandpass circuit to exactly the desired characteristics.

Price of a typical kit-form sweep generator is about $40. It won't be one of the first items of test equipment you need, but once you use it you'll find yourself wondering how you ever managed without it for its special purposes.

Tube Testers

Say "test equipment" to the average guy in the street and chances are the first thing he'll think of is a tube tester. This is one everybody knows. Yet it's bringing up the end of the line here. Why?

The answer is that for ham use, a tube tester is probably the least-needed item of test equipment. In the first place, commercial testers will handle only receiving tubes and a few of the lowest powered transmitting bottles. Secondly, if you want to use a tester you can find one at almost any supermarket or drugstore.

And at the bottom of it all is the fact that the only sure test for a tube is to substitute a new one and see what happens. In ham applications this is more true than ever, since we so often use tubes for purposes their designers never dreamed of.

Tube testers come in two basic types, called "emission" and "transconductance" testers. Most of the drugstore type are emission testers; these kind check all tubes as diodes, and tell you how well the cathode is emitting electrons. The idea is that as a tube gets weaker its emission drops.

The transconductance tester, on the other hand, tells you how much control over the plate current the control grid still has. Emission is tested by implication here, but the control is the important thing. Since this is a closer approximation to true operating conditions, this is generally thought to be a better test.

Emission testers may be purchased for around $15 to $30. The transconductance types cost several times as much, and the top model of transconductance tester will set you back well over $1,000.

The Complete Ham Lab

Way back at the beginning, we promised you a schedule of test equipment purchases (or projects) which could be taken on in easy stages and would wind up as a complete lab. Here it is.

At the start, there's no question. Get a VOM. Make it a compact one so you can carry it around easily, but don't compromise too much with quality. You'll want it to be at least 20,000 ohms per volt. Expect to spend about $25 here.

Recommended next step is a grid-dip occillator, most easily obtained either in kit form or as a homebrew project. This assumes you already have a receiver; if not, get one before proceeding farther.

With the VOM, GDO, and receiver, you're in position to go for a goodly while with no additional expenditures. But you'll probably want to expand sooner or later, and the recommended next step is a scope.

The scope you get should have at least a 3-inch screen and 5-inch is better. Avoid 7-inch units; they take up too much room for what you get. DC coupling is good, but wide bandpass isn't necessary.

The SWR Meters, frequency standards, and field strength meters will probably have been purchased as station accessories rather than as test equipment. If not, add an SWR meter at this stage.

You may notice that no mention has been made yet of the VTVM; the scope should come before the VTVM, as it will do almost anything of which a VTVM is capable. The VTVM can be added at any subsequent time.

Next major item should be an audio generator, followed later by an rf sweep generator. You can add a tube tester as the last item if you like, but it's not really essential.

If you want to be really exotic, you can add

a "Microvolter" or highly calibrated rf signal generator to the lineup; this is a lab instrument and costs accordingly. However, it will allow you to say "My receiver has a 10 db S/N ratio at 0.5 microvolts on 40 meters" and know whereof you speak. If you don't want to go this far, you really won't need an rf signal generator at all; the GDO will handle that job too.

For the VHF/UHF addict, a noise generator should be added between the grid-dipper and the scope. This is an exceptionally simple homebrew project, or can be purchased for less than $10.

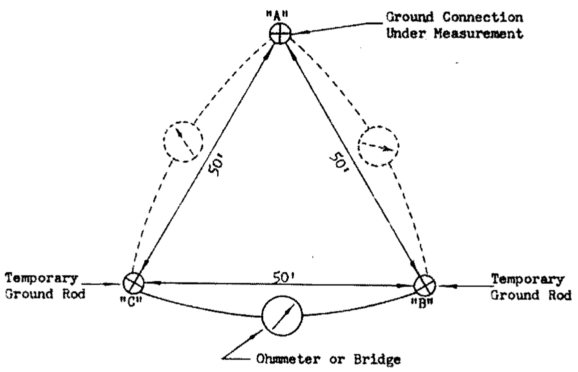
Once you have all this equipment assembled, you should be able to handle almost any problem. The only question will be whether you know how to use it properly—and that's a subject for several dozen more articles!

. . . K5JKX

J. R. Fisk WA6BSO

Practical Ground Systems for Radio Communications

Proper grounding is one of the basic requirements for any communications station, and yet, little published information is available concerning their design. Since antenna performace is standarized with reference to the ground as a perfectly conducting plane, the ground system must approach that condition if the performance of the antenna is to be predictable, dependable and efficient. Although the majority of antenna classics note that an "adequate" ground system is essential, further definition or description is left to the reader's imagination. This lack of information led to the preparation of this article to be used by the amateur as a general guide to the proper installation of good ground systems. It should be pointed out that during the research several discrepancies were found between various technical textbooks and publications. Therefore the data contained herein may be found to be in variance with some established beliefs.



$$R_X = \frac{R_{AB} + R_{AC} - R_{BC}}{2}$$

R_X = Ground connection resistance to be determined

Ground system resistance measurement.

Since the effectiveness of a ground system depends upon the resistivity of the earth, the resistivity encountered at a particular location will be a guide to just how extensive a ground system will be required for reliable high frequency communications. The ground resistivity in meter-ohms may be simply measured by driving two ground rods five feet into the earth, five feet apart. The resistance measured between the rods, in ohms, approximates the earth resistivity in meter-ohms, for the area in question. This earth resistivity is a measure of volume soil resistivity and should not be confused with the resistance of a grounding connection or system.

If the earth resistivity is found to be on the order of 100 meter-ohms or less, a fairly efficient grounding system may be had by the simple expedient of driving an eight foot ground stake. On the other hand, the resistivity is usually found to be somewhat in excess of 100 meters-ohms, and a more extensive ground system is in order.

The ground resistance of a particular grounding system, whether it be a ground rod or a group of ground rods and radials, may be measured by the method outlined in Fig. 1. Here the ground system being measured is designated "A" and two ground stakes are driven into the earth at points "B" and "C", forming an equilateral triangle, fifty feet on a side. Using an ohmmeter or bridge, the resistance of each of the sides is measured. Several precautions should be taken when making the resistance measurements to insure that accurate measurements are obtained. First, when zeroing the ohmmeter, use the probes that will be used in the actual measurement. Since these wire

leads will be in excess of twenty-five feet, care must be taken during the zeroing process to preclude significant errors during measurement. Secondly, when measuring each side of the triangle, take several readings, reverse the leads and take several more. Reversing the leads and averaging the readings will tend to neutralize errors due to stray earth currents which may be in the area under measurement.

After obtaining the necessary measurements, the ground resistance of the ground system may be determined by using the following formula:

$$R_X = \frac{R_{AB} + R_{AC} - R_{BC}}{2}$$

Where: R_X = Ground resistance in ohms
R_{AB} = Resistance measured between "A" and "B"
R_{AC} = Resistance measured between "A" and "C"
R_{BC} = Resistance measured between "B" and "C"

In the event the ground system under measurement consists of a single ground rod, the spacing of the temporary rods can be reduced to ten feet for convenience, if the same configuration is maintained.

When the ground resistance is found to be too high, it may be reduced by using additional ground rods or ground wires, longer ground stakes, chemical treatment of the soil, or a combination of these methods. Each method has its particular usefulness and local factors will govern the selection.

Additional ground stakes are one of the best

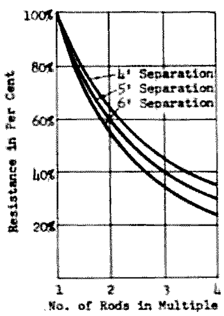


Fig. 2

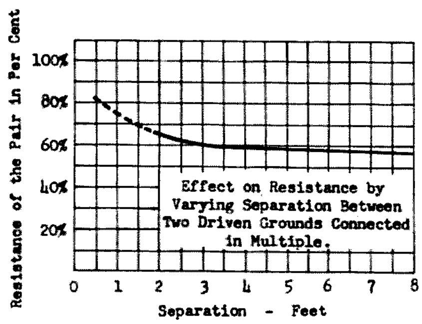


Fig. 3

methods for reducing the resistance of grounds. For example, the ground resistance of a single ground rod may be reduced by 40% by using two properly spaced, parallel connected ground stakes. A 60% reduction may be realized by the use of three properly spaced, parallel connected rods. As the number of rods is increased beyond four, the percentage gain will fall off progressively and economic factors will rule out an excessive number of multiple rods (see Fig. 2). A spacing of five feet minimum between ground rods is much more effective than closer spacing, and may be considered optimum under most conditions where wider spacing is impractical (see Fig. 3).

Copper clad steel rods have properties which make them particularly well suited as driven ground electrodes. They are protected from rusting by a thick exterior of copper molten-welded to a high strength steel core which provides rigidity for driving. Rods less than six feet long and less than ⅝ inches in diameter are usually poor economy because they drive poorly and seldom reach to depths that provide low resistance grounds (see Fig. 4). Eight and ten foot rods can show ground resistance reductions of 22% to 35% over six foot rods in uniform soil. Even greater reductions may be realized over the shorter rods in cases where the longer rods penetrate a water table or other more conductive strata.

From a practical standpoint, however, the rod lengths are often limited by other factors such as handling or driving and the maximum depth to which a rod can be driven due to rock strata or other obstructions. For this reason, the ¾ inch diameter, eight foot copper clad steel rod is usually considered as the standard, with longer rods being used for special applications. Increasing the rod diameter above ¾ inch does not materially reduce the ground resistance and considerably increases the rod cost due to the added weight of necessary metal.

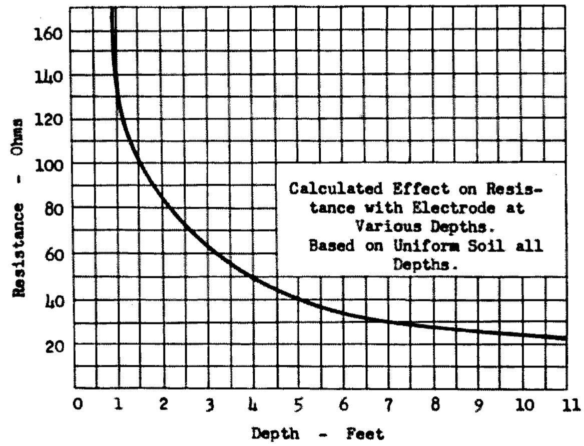
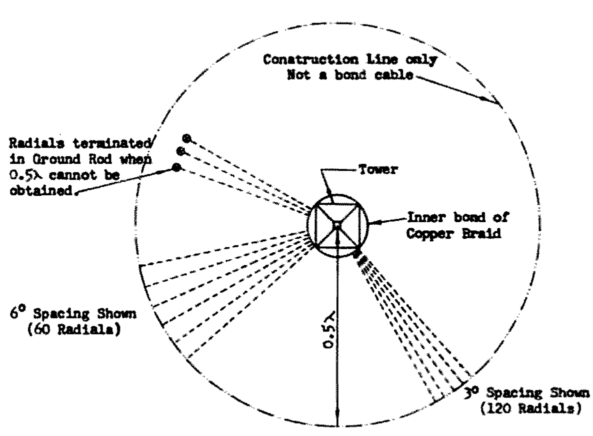


Fig. 4

No vertical antenna can perform efficiently without an adequate ground system, since the conducting ground serves as a part of the antenna system. A line of electric force extends from the top of the antenna through surrounding space to earth. Upon entering a perfectly conducting earth it becomes a conduction current which returns to the base of the antenna and becomes a portion of the antenna current. Although other types of antennas are not as dependent upon a ground system as the vertical, a good ground system will increase the efficiency of nearly any antenna system.

The configuration of the ground wires of a buried or surface ground is dictated by the natural path for return ground currents. Therefore, they will lie radially about the base of the



Example of Ground System for Vertical Antenna

Fig. 5

antenna or supporting tower. At the tower base they should connect to a heavy girdle of cable or flat bus which is connected to the tower base elements in the case of a grounded tower, or to the insulator base in the case of an insulated antenna. Electronic components of the antenna tuning unit which are at ground potential should also be bonded to this bus. If the radials are 0.4 to 0.5 wavelengths long at the lower operating frequency, there will be a resultant zero current at the ends of the radials, and there is no need for terminating the radials in ground rods. If the radials cannot be made sufficiently long due to property boundaries or other restrictions, ground rods at the periphery should be used. Contrary to popular belief, circular bonds along the length of the radials are undesirable because they cause indirect return paths and eddy current losses in the closed loop circuits of the mesh formed by such bonds (see Fig. 5).

The theoretical perfect ground is approached when 120 radials (one every 3°) is employed, each radial being 0.5 wavelength long at the lowest operating frequency. For practical purposes, half the number of radials (one every 6°) will be 95% as effective as 120 at a 50% saving in copper and labor. Thirty (one every 12°) will be about 90% effective as 120 and is a good compromise. Normally, less than 30 radials should not be considered in a permanent installation (see Fig. 6 and 7). The inherent configuration of the radials allows the amateur to initially install the number of radials commensurate with the family budget, and then to add more at a later time when funds become available.

Conductor size is not too important except from the mechanical viewpoint. For a permanent installation, wire smaller than #12 AWG is not practical due to corrosion loss. The wire depth is not at all critical and three to six

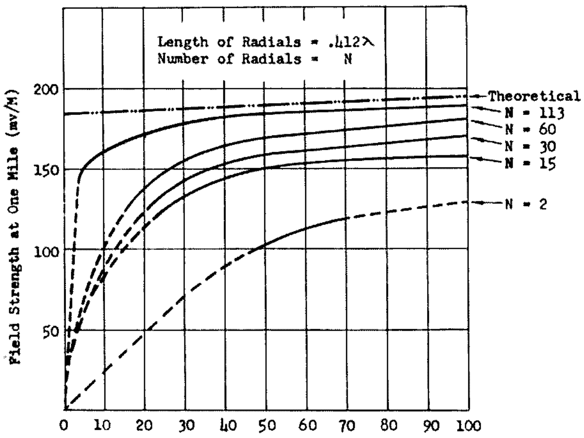


Fig. 6

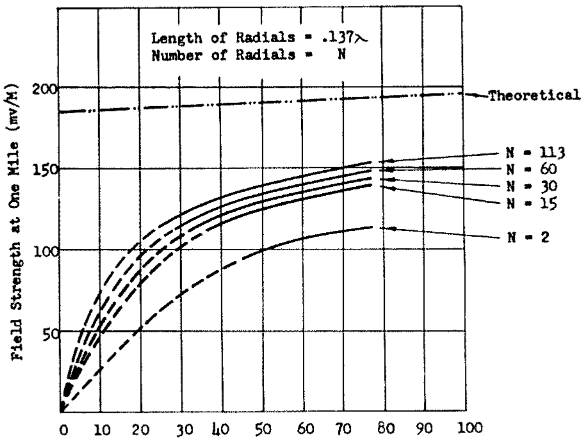


Fig. 7

inches is a good compromise between ease in laying and mechanical protection. Laying the wire on the surface without cover should be avoided except as a temporary measure.

Treating the soil around ground rods is a reliable and effective method of reducing ground resistance, particularly in the case of very high resistance grounds. It is possible for soil treatment to reduce a 1000 ohm ground by as much as 90% (see Fig. 8). However, a similar treatment of a 30 ohm ground would only decrease its resistance by approximately 50%. This method is particularly advantageous when rock strata prevents deep driving of ground rods. Copper sulphate, magnesium sulphate or common rock salt are common chemicals used for soil treatment. The chemicals should be placed in a circular trench about the driven rod (see Fig. 9), or in an adjacent porous container (see Fig. 10), but not in direct contact with the ground rod. The addition of water tends to disperse the chemicals downward by leaching action. improving the result. Normally a protective earth cover is provided the circular trench.

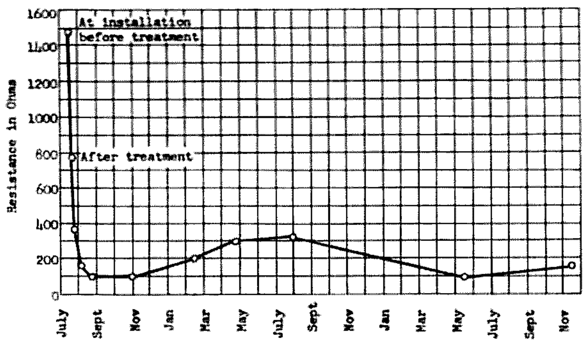
Many ham shacks are located on elevated hills or mountains where they provide the highest elevation in the vicinity. These sites are usually dry and rocky and the soil resistivity is consequently high. Often the rocky ground precludes the driving of ground rods in the immediate vicinity of the station. For such installations the grounding system should take the form of buried radial wires or even surface conductors if the rocky surface precludes burial. However, some burial is usually possible and should be employed if at all possible. The radial wires should be connected to a girdle of heavy cable at the pole or tower and building site. By extending multiple radials downhill fifty to seventy-five feet, natural catch basins of soil can usually be located where the ground rod terminations of the radial wires may be driven. This soil should be thoroughly treated with chemicals to improve its conductivity and catchment basins of earth prepared to trap surface water over the ground rods. Since these elevated locations are especially vulnerable to lightning, sheet metal buildings, coaxial lines and antenna support hardware should be grounded as well as the radio equipment (see Fig. 11).

With the installation of a good ground system, certain procedures should be followed when grounding the pieces of station equipment. Grounds for transmitters should be as short as possible and lead directly to an earth connection. This can best be accomplished by

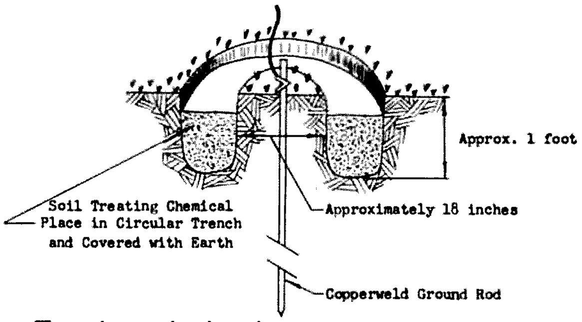
TABLE I

Acceptable Levels Of Ground Resistance

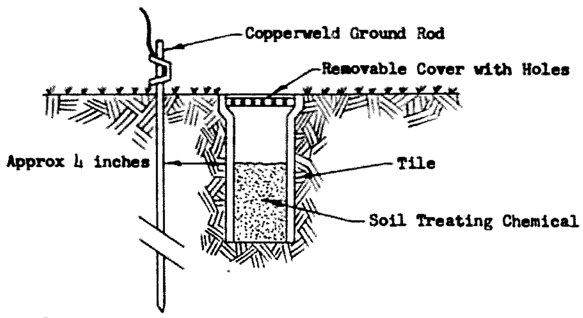
Type of Equipment	Acceptable Resistance (Ohms)	Type of Ground System
Antenna tuning units, outdoor	5	Ground radials and driven rods
Transmitting stations, high frequency	10	Ground radials and driven rods
Receiving stations, high frequency	10	Ground radials and driven rods
Transmitting stations, VHF and UHF	25	Ground radials or driven rods
Receiving stations, VHF and UHF	10	Ground radials and driven rods
Microwave station	30	Ground radials or driven rods
RTTY equipment	30	Driven rods
Telephone pole supports	10	Driven rods
Antenna towers (lighting protection)	10	Driven rods



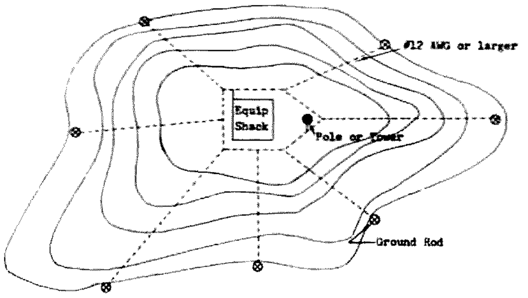
Effect of chemical treatment on soil resistance.



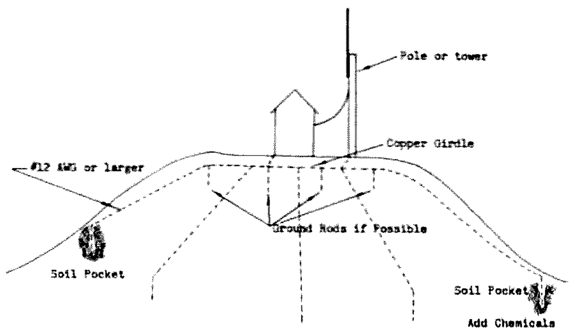
Trench method soil treatment.



Container method soil treatment.



Plan view



Elevation

Grounding and lightning protection of a hilltop site.

placing the ham shack on the ground floor, but in the case of cliff dwellers, is usually impossible. The use of wide, flat busses (such as flashing copper) for ground leads provides a much lower radio frequency resistance than stranded cables or round conductors of the same cross section, and their use is recommended whenever possible. Transmitters with improper grounds or elevated above ground usually have cabinets that are hot with radio frequency energy with consequental tuning difficulties and resultant TVI complaints. Sometimes improper ground of high power transmitters will allow radio frequency hot spots (voltage anti-nodes) to develop on ac house wiring, causing eventual insulation breakdown.

The ground conductors for radio receiving equipment should be carried to a low resistance ground without contact with grounds that serve alternating current power systems. Eventual connection, either planed or accidental, is inevitable, but this should not occur before the receiver ground is firmly connected to earth. For this purpose, the grid provided by a copper piped sprinkler system under an extensive lawn is an excellent receiving ground system. Thus, the use of a "noisy" ground, which would increase the noise threshold of the receiver, is avoided.

Special care must be taken when grounding the shields of audio and microphone circuits where any considerable length is involved. The ground should be applied to one end only, usually the equipment end, and the microphone, pickup or speaker end is allowed to float above ground. This procedure avoids inductive loops which would result if another ground, either planned or accidental, were added to the line. In low level lines a small amount of inductive pickup usually results in excessive hum and undesirable noise in the amplified output.

Although the ground system of an amateur station is usually approached form the standpoint of improved communications, a good ground system is very necessary for proper lightning protection. Metallic radio towers are a natural target for lightning and grounding which will harmlessly dissipate the energy is essential. If the tower is used as a support for a rotary beam, it may be directly bonded to ground rods through a heavy bonding cable securely lugged and bolted to the tower (see Fig. 12). If the tower is insulated from ground as with some vertical radiators, the ground system is connected to the lower member of the antenna insulator which will arc over for lightning protection, but will not beak down

under normally applied radio frequency energy.

Telephone poles being used to support open wire line or antenna cable may be protected from shattering by severe lightning by running a #8 AWG copper or aluminum wire from the top of the pole to the ground. A continuous ground wire from the top of the pole is also used on antenna poles which carry coaxial leads or require a ground for antenna coupling units or terminating resistor boxes in the case of a rhombic antenna system. Where an equipment ground is not required and only lighting protection is necessary, the wire running the length of the pole should be divided into a series of short lengths not over a quarter wavelength long. Lengths of ten feet are suitable up to 20 mc, and lengths of seven feet to 30 mc. Each length is terminated in a rounded loop stapled to the pole, but drawn away at an angle of about 45°. The adjacent wire should be spaced to form a gap of ⅜ inch between loops. The top of each pole should be equipped with an eight foot copperweld ground rod clamped in upright position to extend six feet above the top of the pole and securely attached to the ground wire. The ground wire should be terminated at the butt of the pole by forming a spiral of several turns stapled in place. Additionally, an eight foot ground rod is driven into

(Turn to page 62)

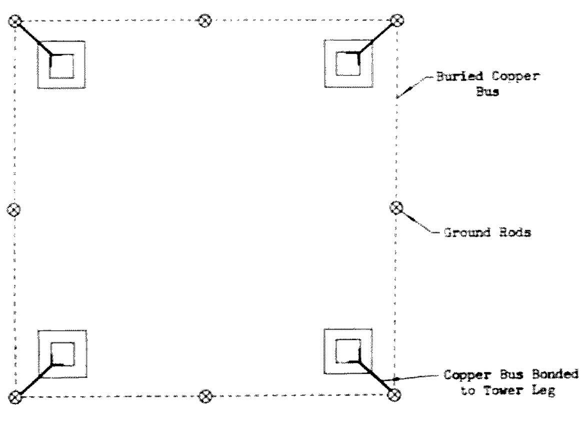


Fig. 12a

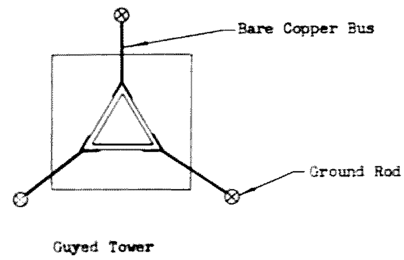
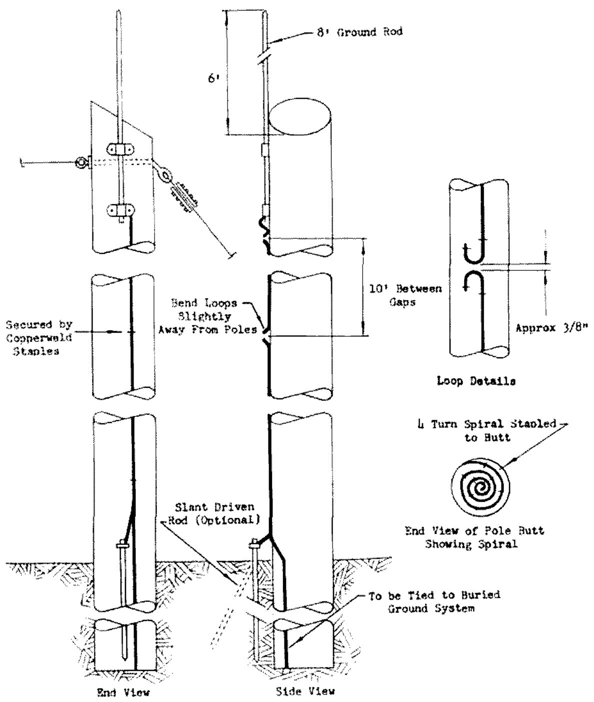


Fig. 12b

Lightning protection of towers.

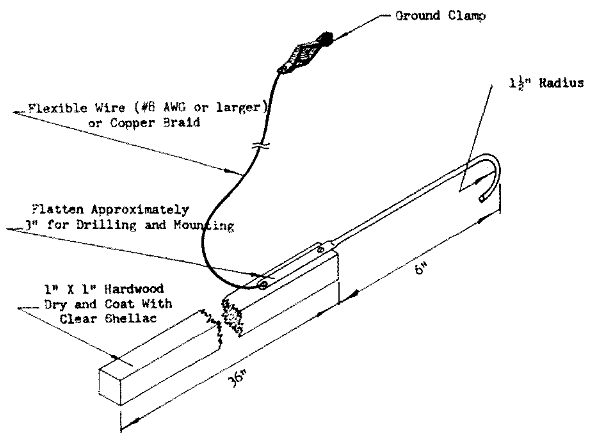
NOTE:
Ground cables connect to base of tower. In the case of insulated radiators, ground cables connect to lower member of insulator.

(Ground Systems from 59)



Radio pole protection.

the earth one or two feet from the base of the pole and attached to the ground wire with a heavy cable. Slanting the rod away from the pole to contact undisturbed earth often increases the rod's effectiveness. Copperweld staples should be used throughout the installation due to the deterioration of the ground wire due to electrolysis if galvanized staples are used. (See Fig. 13).



Construction of shorting stick.

NOTE:
Solder all connections to insure low resistance path to ground.
Connect ground clamp to ground before using probe. Remove shorting stick before turning power on.

Grounded frames and chassis form a large part of most electronic equipment in a properly grounded installation. To a person in contact with a part of the circuit above ground potential, contact with a grounded member can have a lethal effect. For this reason, the old adage about working on a transmitter with one hand in your pocket was developed. However, this is not enough if your knee or your head is in contact with the grounded surface. Therefore, when working on a transmitter or other piece of equipment where dangerous potentials are normally applied, the power should be disconnected and a grounding hook applied to the part of the equipment to be worked on.

The grounding hook can be composed of a hook of ¼ inch copper tubing attached to an insulated handle and carrying a length of flexible braid terminated with a good sized battery clip. The clip is attached to the grounded frame or chassis, and then, holding the insulated handle, the copper hook is hung on the exposed high voltage members. The individual is then protected against charged capacitors, accidental application of power, or failure of interlock devices since the ground path provided by the grounding hook will shunt the potential to ground and trip the circuit breaker or blow the fuse. Momentarily grounding the circuit with a screwdriver is no protection against accidental reapplication of power or high voltage capacitors which require a continued discharge path to drain their charge (see Fig. 14).

The information contained herein is definately not all inclusive, but by following these proven grounding procedures, the amateur can be assured of an installation comparable to any high frequency communications facility. Results will be in the form of more reliable, dependable communications and peace of mind as to lightning protection and safety.

. . . WA6BSO

BFO

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A standard superhet short-wave receiver may be unable to be used for CW (code) work because it lacks a beat frequency oscillator.

The bfo does this job by providing a fixed signal at a frequency close to the receiver's if. The bfo's signal is combined with the receivers if signal and the resulting signal is a beat that

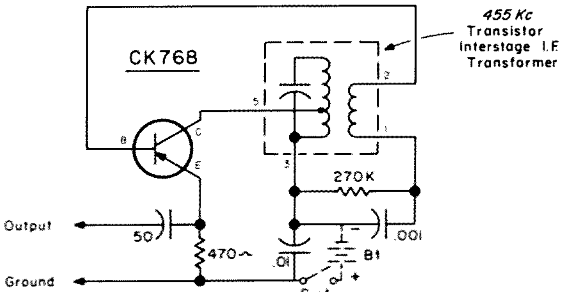
is audible through a pair of headphones or a loudspeaker. All communications receivers have built in bfo's but few short wave receivers have this feature. However, a transistorized bfo can be added to any super-het receiver.

Refering to the schematic diagram we see that a CK768 rf transistor is used as a common emitter oscillator.

In operation, the oscillator's frequency is determined by the turned primary winding of the if transformer, with the feedback necessary to start it oscillating. The output signal is obtained across the emitter R_1 through the coupling capicator C_1.

Operating power is obtained from a 6-9 volt battery.

The bfo switch should be mounted on the front panel of the receiver. A lead is run from the bfo's output terminal to the last if stage in



the receiver and wrapped around the last if amplifier's grid lead, forming a gimmick capacitor.

To adjust the bfo, connect a standard rf signal generator to the receiver and turn the receiver and the signal generator on but leave the bfo in the off position. Adjusting the signal generator to supply a modulated rf signal, carefully tune in this signal and switch the modulation to off and turn the bfo on. Adjust the bfo's operating frequency until a tone can be heard in the loudspeaker. Do this by using an insulated alignment tool to adjust the bfo's if transformer's iron-slug.

After this preliminary adjustment the bfo may be readjusted to give the tone you prefer.

. . . K1YVB

The Z-L Special for Forty

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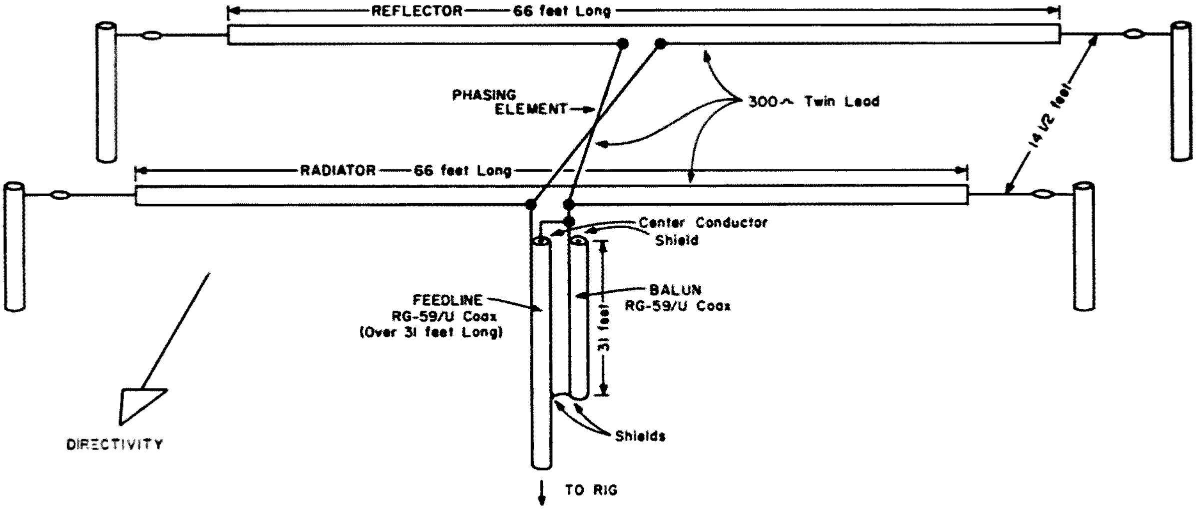
With the present calamity of those ever decreasing sunspots (bless them) casting its horrible wrath upon humanity for an (oh woe is us) eleven year duration, many a DX man creeps forth from his established twenty meter haunt and emits some wild ideas of operating on forty. His hot-idea cools down to a solid as soon as he pages through his catalogue and recovers from those staggering prices on commercial beams for that band (no one would dream of using a dipole).

Here's where I come in. It is my intention to interest you in a beam antenna array with at least 7 db gain over the dipole, and none of those earth-shaking dimensions exhibited by such monsters as the rhombic. The most interesting factor about this antenna is that it can be had for as little as the cost of two strips of 300 ohm twin line, each 66 feet long, some insulators and coax feedline. That's right, no mismatch in this antenna and you feed it with your existing RG-59/U.

Physical dimensions? The directive array consists of radiator and reflector elements spaced 14½ feet apart. Good results were obtained by feeding the two 66 foot lengths of 300 ohm line with a simple balancing balun (Fig. 1), consisting of a 31 foot length of coax taped to the feedline.

In comparative tests between the forty meter ZL special and other conventional antennas, such as the dipole, inverted V, V-Beam, long wire, and a two element commercial beam proved that those 7 db's are nothing to be sneered at. All tests showed similar results between the commercial beam and the ZL.

Refinements in construction are possible, but the simplicity proves that an effective forty meter array is not as hard to come by as one might think.



The Rx Audio Probe

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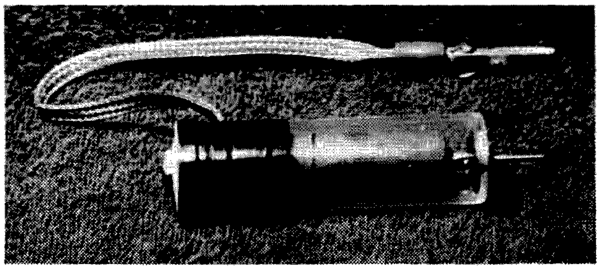
A need for a simple method of checking audio stages prompted the development of the Rx probe. The unit is basically a blocking condenser for headphones or a small speaker. Headphones are usually preferred to a speaker, particularly when checking stages associated with microphone input. The headphones permit one to use a microphone for testing without contending with feedback.

The "probe" has been used for several years for trouble shooting such audio problems as checking for non-operative stages, hum, loss of gain, or distortion, and in units such as Vox to determine if absence of audio is resulting in poor Vox action, etc. I would suggest that the probe not be used to check audio stages such as the output of a five hundred watt modulator —if you do, please notify the next of kin before the explosion! Seriously, the little unit is very handy for working on almost all low level audio stages or small amplifiers.

The construction of the "probe" is very simple and will take only a short time to complete. The case is a small plastic medicine bottle ¾ inch in diameter and 3-¼ inches long (total cost $8.75, including pills). These are used extensively throughout the country in distributing patented medicines and should be found at almost any drug store.

CORRECTION

In the 50 mc DSB article, page 16, Dec. '63, please change the 12AU7 plate RFC to ground instead of B+ on the schematic.



Drill a small hole in the bottom of the bottle to accomodate the metal tip. The one shown in the photograph was removed from an old VTVM probe (these tips are available separately from the radio supply stores). Drill a 5/16" hole in the bottle top and mount a headphone jack in it using half-inch diameter washers on each side of the top for support. Cut a small slit in the bottle ¼" wide and about ¾" down from the top. The slit provides a convenient exit for a braid that is used for the headphones ground return. Solder the braid to one of the phone jack lugs and connect the negative end of a .25 mmfd 400 volt condenser to the remaining lug. Solder the positive end of the condenser to the metal tip and slip the components into the bottle. Snap the top on and bolt the tip to the bottom. Pull the excess braid out of the bottle and solder an alligator clip to the protruding end to complete the construction.

Operation of the Rx probe is quite simple. Just plug a set or headphones in the jack, connect the alligator clip to the audio ground, place the probe on the plate of an amplifier tube, and the input signal to the amplifier should be heard in the headphones. Only ex-

perience and good judgement will now assist you in evaluating the received signal. However, these hints should enhance your experience factor.

(1) A deep low hum sometimes modulating the broadcast or amplified signal: check the power supply filter condensers and rectifier tubes.
(2) An undue weak signal: check for tubes with low emission, faulty by-pass condensers, or low screen or plate voltages.
(3) Erratic signal: check for cold solder joints, faulty volume control, coupling condensers, and voltage dropping resistors, or an intermittent short in a tube.

This list could continue on into the night and never be complete, so couple some common sense to some good basic electronic study and the experience factor will grow like a weed in a flower garden.

One word of caution—*Do not exceed the voltage rating of the condenser used.* Also, I have found it saves the ear drums to ground the probe after checking each tube element, because the discharge of a condenser over the earphones clamped to your head aproaches the repercussion of being hit on the head with a baseball bat. . . . W5VOH

Neutralization

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Ever hear of a "neutrodyne" receiver? Or see a transmitter composed of three or four big bulbous bottles with neutralizing condensers of equal size reposing alongside, all mounted on a long wooden board?

If you're an old-timer, of course you have. But to those of us who have entered the radio game in the last decade or so, neutralization may easily be a slightly strange and little-understood subject. After all, beam power tubes don't really require neutralization, nor do the high-performance pentodes which mark all present receivers. Or do they?

To unsnarl a bit of the confusion, we're going to take a deeper-than-usual look at the subject of neutralization. We'll first see why it's needed, then dig into just what it really amounts to, and finally run through the various ways of putting all this into practice—including one way which (though described first some 6 years ago) has been apparently ignored by almost everybody, yet seems to be the fastest and simplest of all.

Want to come along? Let's go!

First, let's find out why neutralization is needed. Before we can do this, we'll have to define the term "neutralization", and to make our trip as meaningful as possible we're going to use a definition not normally seen in ham circles. We'll call neutralization "the process of providing only one route from input to output of a single stage."

Why such a cumbersome and "oddball" definition? For one thing, it includes all the more conventional definitions. For another, it makes our findings apply to transistor circuits as well as to tube types (transistor neutralization is usually called "unilateralization" by the engineers, which is just a squeezing of our definition down into one rather long word).

The usual answer to the question "Why neutralize?" is "To prevent oscillation." It's pretty easy to see that if any of the output of an amplifying stage gets back to the input, it will be amplified still more and this round-robin leads to oscillation. The technical term for this, which we're sure most of you already know, is "positive feedback", and the more usual ham slang is "regeneration".

Note that nothing is said about the route by which the output makes it back to the input. However, any circuit component except a perfect tube (one without interelectrode capacitances) will allow signals to pass about as well one way as the other. Even a crystal diode will let part of an ac signal through in the back direction. And *any* route will allow some regeneration.

Putting that last paragraph all together begins to answer the question of "Why neutralize?" No tube is perfect; there's always some interelectrode capacitance. This capacitance provides a route for output energy to get back to the input. There, it can cause regeneration—and if regeneration is great enough, the stage will oscillate.

This is shown schematically in Fig. 1. The tubes in Fig. 1 are considered to be "perfect" and have no capacitances; the actual capacitances present are shown as capacitors outside the tube.

In the triode, Fig. 1A, we have only three such capacitors to bother with. Cin can be considered as merely part of the input tank at rf, and Cout is merged into the output tank the same way. However, Cg-p is a route—and a pretty good one—for output to get back to input. This route is so good that it's a rule of thumb; triode rf stages must be neutralized to prevent oscillation.

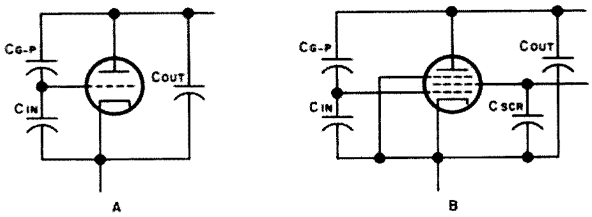

FIGURE 1

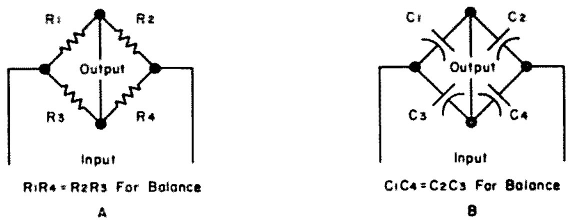

FIGURE 2

How about the pentode, Fig. 1B? Here we have a whole lot more capacitors; not all are shown in the figure. The four which are shown are the most important. Cin and Cout disappear as before; at low frequencies Cscr tends to disappear into the bypass capactor. However, Cg-p remains as before.

The difference, of course, is that Cg-p in a pentode is much lower than in a triode, since it is composed of three capacitances in series and both the screen and suppressor grids are assumed to be at ground potential. Thus at low frequencies or at low power levels the pentode is usually considered to need no neutralizing.

However, as the frequency goes up the screen may no longer really be at ground potential; thus at higher frequencies even the pentode may require neutralizing. We also discover frequently that with the high gain of present pentodes and beam-power tubes even the tiny Cg-p still remaining is enough to mess up the signal, so again neutralization is indicated.

With transistors, of course, the two-way path exists right in the semiconductor itself and so neutralization is almost always indicated.

So now we know that we need to block that Cg-p path from output back to input almost all the time. However, it's built right into our tubes. How can we block it?

We have two basic choices. One depends on the bridge principle, while the other depends on resonances. In addition, a third route exists but has been used only slightly in recent years. This one depends on phasing, and is rather critical in adjustment.

The bridge principle starts with the idea that in a perfectly balanced wheatstone bridge, Fig. 2, none of the signal fed in shows up at the output terminals. The balance of the bridge doesn't depend at all upon the values of the bridge legs, but only upon their ratios.

Since we're dealing with rf energy, the resistors of Fig. 2A can be replaced with capacitors as in Fig. 2B with no change in performance. Now if we can just put this idea to work we can make sure that no path exists from input to output because the bridge can be balanced to eliminate any path.

At first glance, though, the idea seems to explode in our faces. Both input and output to any stage are normally grounded. However, in a bridge, there is no common terminal between input and output. So how can we use it.

Take a look at Fig. 3 and the answer may begin to show up. Fig. 3A is a schematic of a typical pentode rf amplifier stage, without neutralization. Fig. 3B is a representation of the input and output conditions of the stage, redrawn in bridge form.

You can see that the input circuit is not really grounded; it goes to ground through a bypass capacitor, and if an additional capacitor Cn is added from plate to the cold end of the grid coil then we have all the requirements of a bridge, which can be balanced by adjusting the ratios of any pair of adjacent arms to match those of the other pair of adjacent arms.

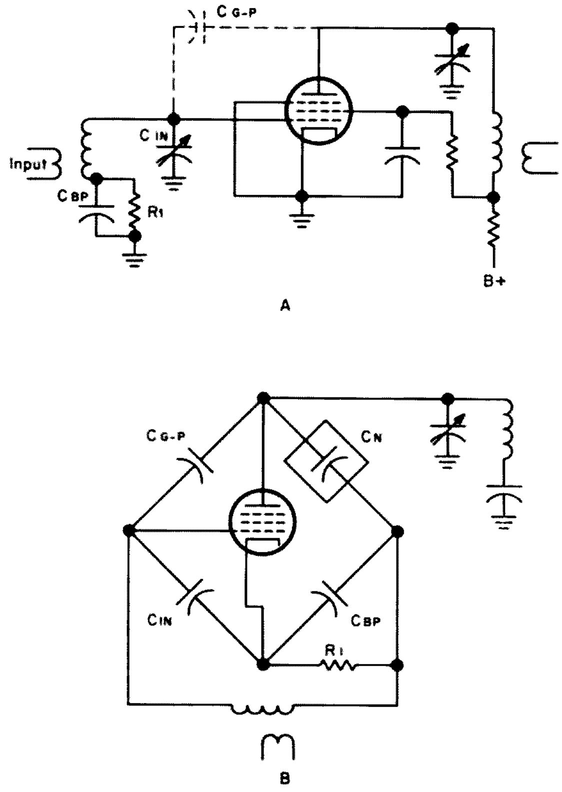

FIGURE 3

Cg-p is fixed. Cin is also fixed but is absorbed in the input tank tuning capacitance, so this can be adjusted. Cn can also be changed as required, as can Cbp. This, then, is a fully practical neutralization technique. Later on we'll see how it is put into practice.

The resonance principle of neutralization depends on the fact that a parallel-resonant circuit acts as a roadblock to any energy at the frequency of resonance.

Thus, all we need to do to cancel out the effects of Cg-p is to add a coil in parallel with it, adjusted to be resonant at the operating frequency. Fig. 4 shows how it looks; since the coil is connected from plate to grid, a large-value blocking capacitor is used to keep high dc voltage off the grid.

This circuit was much used in the long ago, and was resurrected originally in the Wallman cascode circuit for VHF reception. From there, it was adopted in the first Nuvistor preamp used by hams, and has continued to be popular as a result.

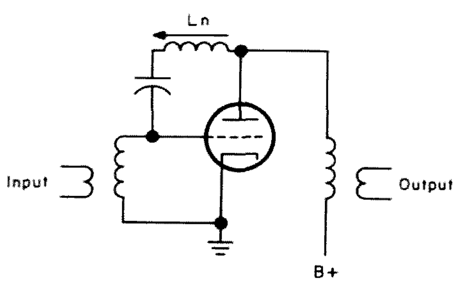

FIGURE 4

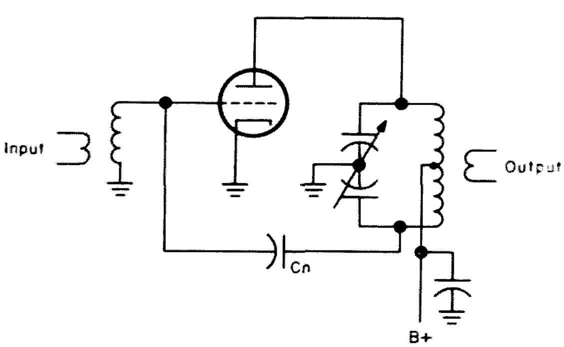

FIGURE 5

However, it has its faults. One—not mentioned in print before to our knowledge—is the fact that if a slug-tuned coil is used to make adjustment easier, and if the slug is grounded (as most are) then any adjustment of the coil will upset tuning of either the grid tank, the plate tank, or both. This comes about because of capacitance between the coil itself and the grounded slug, which appears across the input or output circuit. The remedy is to use a coil form with a floating slug, such as the cheap

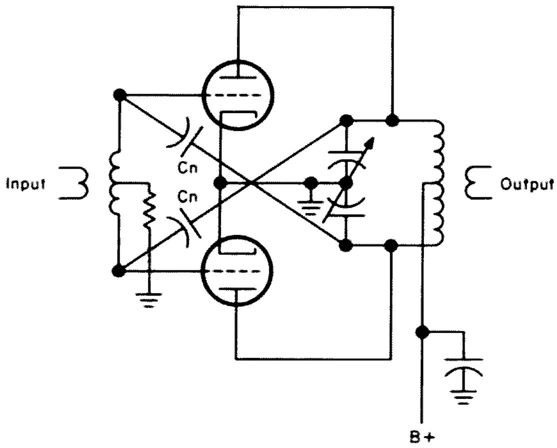

FIGURE 6

little TV jobs with hex-holes in the slug and no external adjustment screw.

Now to the phasing techniques. There are several, all gone into in some detail in the ARRL handbook despite their relative lack of popularity. One of the simplest makes use of a balanced plate (or grid) tank circuit for an otherwise single-ended stage, as shown in Fig. 5. A capacitor exactly equal in value to Cg-p is connected to the otherwise-free end of the tank, and ties back to the grid itself.

Now, any output energy which gets back to the grid through Cg-p will meet an exactly equal amount of energy—but of opposite phaze—which comes back through Cn. The two will cancel out because they are equal in strength and opposite in phase, and the result will be neutralization.

This phasing circuit is not subject to the criticalness mentioned earlier as an objection to phasing circuits in general. However, because this requires a balanced tank for a single-ended circuit it is yeilding in use to the bridge techniques.

In push-pull amplifiers, Fig. 6, you have a horse of a different color indeed. Here, the balanced tanks are already required, and all that must be added for neutralization are a pair of capacitors. This type of neutralization is usually called "cross neutralizing" since the energy "crosses" the zero-line of pushing or pulling.

Many tubes intended for VHF service have cross-neutralization capacitors built right into them. Some of these tubes include the 6360, 6252, etc. Occasionally, however, you may find that even with such a factory-neutralized tube you must still do something, since neutralizing *in the rig* also corrects for such things as coupling between output and input tanks, etc.

Another phasing type of neutralization is shown in Fig. 7. Here, a bit of output is picked

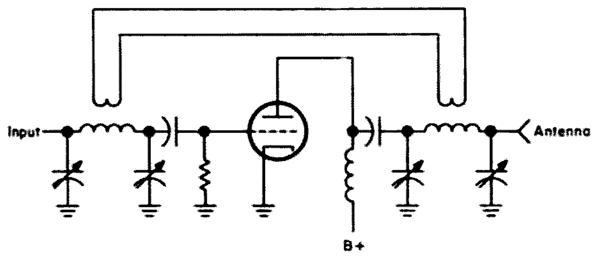

FIGURE 7

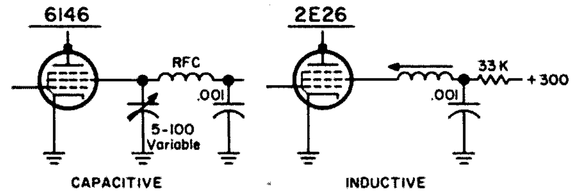

FIGURE 8

off by a loop coupled to the output coil, and is coupled back to the input in a similar manner. This has been claimed to be the only type of neutralization possible for a stage fed from a pi-network and looking at another pi-net for output, although the capacity-bridge will do as well.

This one *is* critical. The coils must be placed and coupled so that both phase and size of the signal passed back is right to cancel the unwanted signal. Since the placement varies not one but two factors at the same time, it's mostly a matter of trial and error. And once you get it set, if you QSY very doggone far you have it all to do over again.

Something that bears attention here, before we go in to the various ways of putting neutralization knowledge into practice, is the idea of just what we're doing when we neutralize a stage. You'll remember our oddball definition: "the process of providing only one route from input to output of a single stage". Now all the way through we've been looking at one special case of an unwanted input-output route; this is grid-plate capacitance. But it's far from being the only route.

For instance, there may be a trace of inductive coupling between the output and input coils. You might even have some feedback via the power supply from one stage to the preceding one, then back to the second-stage grid through normal coupling arrangements. Capacitance across the tube socket is no smaller offender.

And before a stage can be called completely neutralized, all of these unwanted routes must be blocked.

This was hinted at a few paragraphs back when discussing factory-neutralized tubes. We have never yet used one of these tubes which did not require some external neutralization; the only reason which could require external work on these tubes would be unwanted coupling around the tube.

And this fact explains why nobody can give you specific, cut-and-solder-and-know-it'll-work directions for neutralization of anything. Move a coil 1/16 inch, change a chassis from aluminum to copper, use a button-mica bypass instead of a disc ceramic—any of these seemingly minor changes in a circuit *may* require vast changes in the neutralization components because of variations of coupling.

Note that two of the three examples cited above were in the direction of better workmanship, not poorer. However, since neutralization takes care of all other ills (if successful) then reduction of unwanted coupling through better bypassing or more conductive grounds could result only in *over*neutralization when original specifications of the neutralizing circuit are followed.

And overnetralization can hardly be distinguished from underneutralization; both give the same symptoms.

Speaking of overneutralization leads us straight to some thing found only at VHF. Below a region which begins around 50 mc, the representation which we used back in Fig. 1B for a pentode completely valid. However, the lead from the actual screen inside the tube out to the tube pin has some inductance, as do all the other leads, and at some frequency (usually above 50 mc) this screen-lead inductance resonates with the screen-to-cathode capacitance to form a series-resonant bypass circuit.

At the specific frequency at which this resonance occurs, the screen is almost perfectly grounded for rf. At a slightly higher frequency, the screen circuit is equivalent to an inductance rather than a capacitance, like all resonant circuits on the high side of resonance. This inductive component reflects back into the tube through electrode interaction to resonate with Cg-p, and the ultimate result is that at some frequency in the VHF region, any tube is neutralized by this effect, without external neutralizing devices.

This might look rather attractive, unless we stop to realize that the various factors which determine just what frequency the effect shows up at are determined primarily by the physical size and placement of the tube's elements, and are not under our control at all.

And few tubes indeed have "self-neutralizing" frequencies which fall into a useful region for ham purposes. One notable exception is the 5894, which self-neutralizes around 50 mc.

The main reason for devoting all this space

to self-neutralization is that *above* the self-resonant frequency any attempts to neutralize a stage by conventional methods will only make things worse! This comes about because above the frequency at which a tube self-neutralizes, additional external neutralization only adds to the over-neutralization present to start with.

The cure is to reverse normal procedures; in other words, to use the "resonance" type of neutralization, employ a capacitor rather than a coil (because now Cg-p is effectively inductive rather than a capacitance).

This effect is of importance only at 2 meters and above, since most transmitting tubes self-neutralize between 50 and 130 mc.

In this frequency region, one of the simplest ways to combat the problem is to add a method of tuning the screen circuit. Either a variable bypass capacitor, or an adjustable coil in the screen lead, will suffice. By adjusting this control, the self-neutralizing frequency can be pulled somewhat, to move it to the frequency in use. Such a circuit has been used for years in the popular ARRL 2-band 120-watt final for 6 and 2, and the basic circuits for both capacative and inductive screen tuning appear in Fig. 8.

Now to see how to put our ideas into practice. First, of course, we must choose which of the various neutralization methods we intend to use. In general, the resonance technique is currently used most widely in receiver applications, while either the capacity-bridge or the first phasing method is favored for transmitters.

However, the Ameco Nuvistor converters and preamps, which enjoy a wide reputation for fine performance (no plug intended), use the capacity-bridge technique for neutralization rather than the more common resonance idea. So for a start, let's plan out how to neutralize a stage by the capacity-bridge technique.

Looking back at Fig. 3b, we see that the key elements of the bridge are Cin (plus tank capacitance), Cg-p, Cn, and Cbp. The bridge will be balanced when Cin/Cg-p=Cbp/Cn, and also when Cn/Cg-p = Cbp/Cin. Either relationship can be used with equal results, but the two lead to quite different values of Cbp and Cn at times.

Assuming that the stage we want to neutralize uses a 6146, and that the total grid tank capacitance (Cin plus Ctank) is equal to 20 mmfd, let's develop the other values.

The tube handbooks tell us that Cg-p for a 6146 equals 0.24 mmfd. Using the first relation above and dividing Cin by Cg-p to get our ratio, we find 20/0.25 or 83.3 as the value

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which Cbp/Cn must equal. This tells us that if we use a .001 mmfd bypass capacitor, which is the same as 1000 mmfd, we will need a value for Cn of Cbp/83.3, or 1000/83.3, which comes out as 12 mmfd.

However, neither Cg-p nor the precise value of Cin is that predictable, so we make Cn variable over rather wide limits. Acceptable range would be from 3 to 30 mmfd for this example.

When the stage is built, Cn should initially be set to about 12 mmfd. Drive and voltages are then applied, and the stage is ready to be neutralized.

A number of techniques exist for accomplishing this. The time-honored method is to adjust tuning for maximum drive, and dip the plate circuit. If the grid current flickers downward as the plate circuit is tuned, the stage is not neutralized. Move the setting of Cn a hair (caution—high voltage) and try again. If the flicker is larger you went the wrong way. By making it a round-robin technique, you can sooner or later find the point at which maximum grid current and minimum plate current coincide, and this point is taken as perfect neutralization.

A faster and simpler technique is to remove plate and screen voltage from the stage being neutralized, and connect that stage's output circuit to a sensitive rf indicator. W6ZW uses a VTVM equipped with rf probe, K5INC uses an C-meter equipped receiver, and others prefer to use a sensitive SWR bride (when dealing with high enough power levels).

At any rate, no matter what the indicator, drive is adjusted for maximum indication of "leak-through" power. Then the neutralization is adjusted for a null of the leak-through. A virtually perfect null should be obtained unless the indicator is so sensitive that it is picking up signal from the driving stage as well as via feedthrough (a receiver with S-meter can easily do this).

In low-power applications such as receivers, the filament voltage may be removed instead of the B+; this is the usually recommended way to neutralize Nuvistor converters. However, Cg-p may change somewhat when the tube is cold as compared to that at operating temperature, so removing the B+ usually gives a more accurate adjustment.

Once you get the null, the adjustment is complete and you're ready to operate.

However, if you're shooting for really precise adjustment you may discover that Cg-p is not constant with changes in plate current, and Cin varies somewhat as you tune over a band if you adjust the grid tuning capacitor. Both of these effects can un-neutralize your care-

fully achieved adjustment rather easily.

To combat this problem, T. J. Brooks, Jr., W5OSL, made a modification of the standard capacitiy-bridge circuit which has several advantages. For one thing, the neutralization can be adjusted with the rig on the air, even if the power supply voltage runs into the kilovolt region. For another, adjustment is "bandspreaded" so that it becomes much easier.

As described in the January 1958 issue of CQ (edited at the time by an iconoclast from Brooklyn whose call we can't quite place at the moment), the Brooks circuit is identical to the conventional capacity bridge, except that Cbp is the adjustment rather than Cn.

Moving back a moment to Fig. 3B and our previous example, we can determine from the bridge relationships that for neutralization to be accomplished, Cbp must equal Cin times Cn, all divided by Cg-p. If all except Cbp are fixed, then adjustment of the value of the bypass will accomplish neutralization.

Let's run through the previous example again from this viewpoint. Cin will remain, as before, 20 mmfd, while Cg-p is fixed at 0.24 mmfd. Let's use a 4.7 mmfd 3-KV capacitor for Cn, though, instead of the conventional adjustable type, and see what we come out with.

Plugging in the figures we find that Cbp must equal 20 times 4.7, or 94, divided by 0.24. This works out to be 392 mmfd. A standard 365 mmfd BC variable, shunted by a 100 mmfd fixed capacitor, would give plenty of range.

Now let's see what happens if we retune to the low end of the band and Cin rises to 25 mmfd. The figures are now 25 times 4.7, or 117.5, divided by 0.24, which works out to be 490 mmfd. Our 100 mmfd padder wouldn't quite make it, but a 220 mmfd fixed unit would and would still work at the high end as well.

Similarly, if Cg-p changes under the influence of plate current, the variable bypass can quickly be shifted to restore neutralization.

Using the Brooks system, the null technique of actually performing the neutralization can be employed only to find the preliminary setting. Adjustments under full power must be of the grid-current/plate-current type, with grid peak coinciding with plate null.

In the original description, Brooks described use of his system with a 750-watt rig employing a pair of 4-125A's; his variable bypass was a 20-470 mmfd unit. Voltage rating need not be large since only the bias voltage for the stage appears across it.

A similar technique was described in QST by W1HZE, except that he used the variable only for breadboarding to find the proper value of bypass capacitor so that the bridge could be easily balanced with available conventional neutralizing capacitors. He suggested using a triple-section 365mmfd broadcast variable, and for those of us who dislike even the slight arithmetic needed to calculate bypass values it's a good trick.

Now for a bit of wrap-up. It appears that nowhere in these paragraphs did we really show any good reason for neutralizing receiver stages except to avoid oscillation (not that it's not a good reason in itself).

It may get a bit sticky here and there to show why, but we'll have a go at it. From the definition we have established for the process called neutralization, it follows automatically that perfect neutralization eliminates all regeneration or positive feedback.

Now in an amplifier stage, positive feedback isn't a real good thing even if it's not strong enough to cause oscillation. It will give greater gain, but along with the greater gain comes excessive noise and unpredictable variations of the shape of the passband.

The biggest villain, of course, is the noise. A regenerating front end at higher frequencies (15 meters and up) can at times make the difference between hearing and not hearing the signal. What signal is there comes through stronger, yes—but the added noise is also stronger, and overpowers the signal along the way.

This, then, is the reason for accurate neutralization of a receiver stage. When no regeneration is present, the stage will contribute as little extra noise as it possibly can—and we have a better chance of reading those "down-in-the-mud" signals which are usually good DX.

So there it is; an organized tour through the strange mysteries of "neutralization". Now all we ask is that you don't trample us in the rush to fix up the rig the right way.

. . . K5JKX

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More Comments on "Incentive Licensing"

Mr. Collett, a former Director of the ARRL, has a few words for us all.

Over the past ten months the placid surface that normally covers the body politics of Amateur Radio has been slightly agitated.

Beginning in February with the QST editorial. . . . "Restricted voice bands again?" . . . (as a serious and searching question this heading can now be considered meaningless and academic). As events over the months from February indicate; the editorial was planted, the outcome of "favorable" Board action assured and the ARRL Program show "was on the road." However, careful measures were employed to give the entire charade an aura of democratic action.

Last May the ARRL Board acting out the tableau, adopted Director Chaffee's sweeping motion to extend and re-establish an advanced type of license and to thereby give to the ARRL officers—the originators of the "Program"—carte blanche—a blank paper, if you will—to write their own ticket. What the F.C.C. received last October 3rd comprised that ticket. Had the composers of this "ticket" possessed a historical sense they would realize that the era of ARRL "ticket writing" ended in 1948, as we shall presently chronicle.

ARRL's "Program" was filed at F.C.C. in the cause for, and in the name of . . . "the officers and directors of the League—the elected representatives of the more than 80,000 amateurs licensed by this Commission" . . .

To even the casual student of ARRL's speckled and vascillating political career, the assumption of such embracing rights of blanket representation is appalling.

Tedious as history is to many, a review is necessary of the past 15 or so years of ARRL's poiltical conduct in order to evaluate and understand why the American Amateurs stand today unprepared to battle any and all foes of the uncertain future; or even to correct, as of this date, his faults as charged of him by BOTH his ARRL and the F.C.C.

Before we go back to the earlier beginnings of our present dilemma, let us consider various recriminations which the Commission and ARRL spokesmen, salaried and otherwise, have employed in their finger pointing.

F.C.C. spokesmen point up the Amateur's disinclination to emergency matters without realistically acknowledging the partisan character of many of the Civil Defense radio installations. Further, the Commission seems fascinated by sheer numbers rather than the quality of performance in emergency communications achievements. Can this attitude project an atmosphere for future CB frequencies to be considered?

Conversely, the ARRL requests the Commission to enact it's "Program" even though it will be . . . "perhaps unpopular"; which by innuendo infers previous laxity by the enforcement agency, and that the Amateur's present plight is the responsibility of the F.C.C.

After more than 40 years of assuming ENTIRE . . . "representation of the radio amateur in legislative matters" . . . the League officers seem to unwittingly and belatedly confess of their lack of requisite leadership in Amateur affairs.

"Act," the League's counsel urges, "promptly and favorably on this petition" . . . and prior to this the astute counsellor states, . . . "the warning signs are too numerous to be ignored" . . . Who, may we inquire woke this gentleman up? And what, we pray, has the capable Mr. Paul Segal been doing all these years?

The thousands of amateurs that built the successful publishing business that is QST today, that bought and paid for a new building where QST is housed, are now ironically charged in QST pages and F.C.C. petition with a delinquency they are little aware they possess. Cannot the truism about . . . "no delinquent children just delinquent parents" . . . be restated here?

To now argue or re-emphasize that Amateur Radio is a service and not a hobby is at this late date merely a scapegoat rebuttal by League officials to escape their basic responsibility. Tacitly it is an admission of lost opportunities, a spilled milk philosophy.

Let us, historically, now review some of these lost chances to provide true leadership to the then, and now, rudderless and bewildered Amateurs that make up the membership of the ARRL.

At its Board meeting in May, 1948, the ARRL Board was offered this motion by then—Director Richelieu of Milwaukee . . . "Moved, that a League (ARRL) branch office be established and maintained in Washington, D. C., and manned by capable personnel well versed and trained in Amateur Radio practices with regard to public relations and governmental contacts so essential in organizational welfare."

Did ARRL Officers and Directors embrace this plan to further the Amateur cause on a National scale? Or similar motions of the same category offered by other Directors throughout the late 40s and early 50s? Or would the League's official family even condescend to consider another motion made at the 1948 meeting . . . "Moved, that a permanent committee be formed to study and recommend all possible means of (to) solidify the Amateur's position with the general public and the Government of the United States. . . ."

QST for July 1948 marks the burial crypt of these motions. These blueprints for leadership offered the League so very long ago, are, by their disinterment an indictment of the League's perpetual policy of remaining inactive as respects politics on either the National or International scale through the IARU. The compelling reason for the ARRL's continued silence and non-political policy is to assure a continuation of the League's tax exemption status. The cost of this administrative engrossment with fiscal frugality can be incalculable. We have no desire to be the world's richest FORMER license-holders.

Activities by other tax exempt groups along the Potomac, lobbying for their special interests seems to go unnoticed by our League leaders. Acknowledgedly, to successfully project the value of Amateur Radio far and wide costs money, and at the minuscule membership fee of $5.00 little in the field of exploiting our virtues can be accomplished. This pittance for a years' membership, paid for by many that blow a $25.00 tube with a philosophical shrug, is inexcusable and further marks the lack of leadership at ARRL Board level. Let the League take prompt and positive action to enhance our image, at home and overseas and then dare to hand the bill for such necessary and long overdue work to the membership of the ARRL. Political suicide? Well, minus such action by SOME GROUP, SOMEWHERE, all members of the ARRL Board will unquestionably be referred to in the previous sense . . . in any case.

Raising membership fees would take guts and a vision that transcends thoughts of re-election. To state a fact of political life perfunctorily, to assure yourself second place, skimp on the buck!

If present League officers are uncertain that bedrock political activity here and now, and especially to and with foreign delegates will not better our position at the next International conference, then they should have their respective noses wiped and be replaced by a realistic Board of Directors. Amateur Radio can no longer enjoy the luxury of such political naivete.

In Amateur Radio's future there should be more than entertaining and exciting QSO parties wherein bigger and bigger scores have been the innocent way of life for so many of us. In its "Program," seeking . . . "upper-level incentive licensing" . . . the ARRL officers ask, seemingly for a new broom with which the cobwebs of operational decadence can be hopefully swept away. In all that we have read and heard since the February editorial emerged, there has never been mentioned printed or said as to what group of Amateur Radio representatives MIGHT be responsible for the cobwebs of our present day indifference to the style and manner of our conduct, now, suddenly so important to our ARRL officers. The membership could wisely use a new broom, also.

The history of Amateur Radio is one of constant and ever present insecurity. To have continued under such precarious conditions is almost entirely due to the efforts of Hiram Percy Maxim going back, now, to 45 years; and aside from this life-saving work of our first ARRL President and League founder, it grows increasingly obvious that Ham Radio's political fences have had little attention since his era.

Only one important ARRL Board meeting has ever been held in the Nation's Capitol, and that only because of F.C.C.'s Docket 9295, and the rapid growth of organizations other than ARRL purporting to represent Amateur Radio. The true history of the Docket 9295 has never appeared in the pages of QST either for the enlightenment or education of the League's membership. In retrospect this omission now takes on significance. An uninformed membership makes few demands on those empowered to represent them.

Briefly, Docket 9295 original concept flowed out of the 1948 Board meeting of the ARRL and the failure of that body to adopt many of the proposals thereupon offered. The historic votes of 14 to 2 crushed much of the progressive program offered the 1948 Board that conceivably would have strengthened the ARRL policies then and forestalled the present predicament.

Many leading Amateurs, in and out of Government service, in the area of the District of Columbia importuned the F.C.C. to take action to halt amateur radio's drift along a leaderless path to obsolescence. To these and many other amateurs, the ARRL no longer deserved the long enjoyed—albeit unofficial privilege of writing its "own ticket." During this fateful year for Ham Radio the services of its most skillful politician were lost through the passing of K. B. Warner. This, likewise, had an impact on subsequent events that culminated in shaping Docket 9295.

Late in the fall of 1948, League Secretary Budlong was invited to review the draft of 9295 in Washington. One hurried reading made "Bud" realize he had ahold of a 'hot potato"; that the passage of the Docket would have tremendous effect on amateur radio. He immediately informed the then League President Bailey of the Docket's content. This individual did not officially inform his Board of Directors of the Docket for several months, thus not allowing ample time for the Directors to contact their membership. At the time the plea was advanced that League officials were sworn to secrecy. The Docket to become a law had first to be made public, as required by law, and fortunately this is, not yet, a country of secret laws! Bailey's oversight, whether by design or accidental is said to have inspired his retirement at the next ARRL presidential election by the Board. The final Docket 9295, as referred in the League's "Program" petition in November QST, was passed very much watered down from it's original draft. Briefly, however, there was some unprecedented accord within Amateur ranks, but, unfortunately, only briefly.

Regretfully, after many years, these events are recorded for the first time, not to demean or calumniate any individual but rather to reveal wherein a system of reposing our complete faith in a single image has a fallacious foundation and an end of positive finality.

To most Amateurs the image of ARRL parallels the respect with which they hold their religion. To many this faith is absolute—and blind. As normal citizens most Amateurs give weightful thought as to their selection of a national representative; even occasionally writing these members of Congress. As Amateurs—when they vote for their League Directors, they question the incumbent NOT, but term after term return him to office This political insouciance in ARRL political affairs stemming, perhaps from the hobby image breeds official indifference the like of which can be detected in the genesis of ARRL's petition on Incentive licensing.

For this "Program" may we suggest the epitaph, "Alas, so very little and so very late."

Len Collett, KZ5LC
Box 736
Balboa, Canal Zone

Still Move on "Incentive Licensing"

The story behind this release should be of interest to those who have read Prose Walker's article in the October 1963 issue of QST.

Last April Prose Walker of Collins Radio, formerly an FCC expert at ITU conferences, clearly indicated to a number of key ARRL people and the writer that unless a major effort was made well in advance of the next ITU conference we amateurs were quite probably going to lose our HF assignments.

This release was prepared and distributed to the ARRL Executive Committee, hoping some evidence of action would be forth coming from this Committee. No evidence of action, even of any interest, has been fed back to the writer.

The question can be answered and should be answered promptly by the leaders of the ARRL. Does the ARRL Executive Committee believe our HF assignments are in serious danger? If the answer is negative, quite obviously others who feel differently about the matter should initiate action in accordance with their own beliefs.

If the ARRL Exec. Commttee feels there is a real and ever growing danger, is it willing to battle with all the tools of the trade used by our enemies or is it committed to a policy of being nice guys with martinis for everyone in the house after we have lost the battle.

The basic question seems to be, do the amateurs really want to put up a real fight on a "no hold barred basis" for the retention of our high frequency bands?

1. Can the ARRL make the tremendous effort needed to stem the tide of frequency grabbing from the amateur radio service now in the making between the international broadcasting and point to point radio services of 30 odd new governments and a substantial number of the 70 old so-called old countries.

2. Is it geared to such an effort management wise and/or tradition wise.

3. The record at ITU conferences for the past 40 years clearly indicates that the only service to lose frequencies at these conferences is the radio amateur service.

4. With recent addition of 30 new countries all wanting frequencies it is quite obvious that unless some constructive work is done, pressures to eliminate the radio amateur service from the high frequency portion of the spectrum at the next ITU conference will reach an all time high.

5. Are the ARRL officers and directors afraid to do battle with one or more segments of our own government, particularly the Voice of America section of the State Department?

In all probability the answer is yes. Like the majority of Americans benumbed mentally by the stupendous magnitude of our Federal Government they have forgotten this is still a Republic and still is of and for the people (if they will get up off the floor and fight) and still has the checks and balances of the Congress the Presidency and the Supreme Court.

They probably will have tremendous doubts of the strength of a lobby which can be established to work for our continued existence in the high frequency portion of the spectrum and therefore abandon hope at the outset.

6. Would they authorize the expenditure of the funds necessary to a good job? This too is highly questionable as this might cost as much as $100,000 a year for three or four years at least.

7. To sum up the situation, the ARRL leadership, while it is clearly aware of the dangers to our continued existence on the high frequency bands is on the horns of a dilemma.

This is the cheap way out but even an idiot can tell this will mean total disaster at the next ITU meeting.

The concept of hiring professional lobbyists and technical consultants to do a professional job in a highly specialized professional field is just too much to expect from most ARRL leaders.

Is it really worthwhile to retain our amateur simon purity intact and let others disembowel us behind the scenes with every dirty trick in the book?

8. Is the best way out the formation of a new organization of amateurs primarily with professional radio background who are fully aware of the realities of dirty politics, back room deals, how to stir up Congressional pressure in the Administration when necessary and all the professional tricks of the trade which are as little known at Newington, Conn., as they are in Elko, Nevada.

Such a group will need a mouth piece in the form of a magazine. It will also need lots of cash. Both should be readily obtainable, particularly when the average ham with better than $1000 worth of gear finds out what his chances are of converting it to the scrap heap, unless drastic action is started immediately to protect his interests.

9. The hardest task is to get the ARRL leadership to commit themselves. Instead of holding an Executive Committee meeting for a week with an agenda devoted to this subject exclusively, meetings are held for one day on important matters like League Affiliation grants to various radio clubs, incentive licensing (which is a big mistake) when amateur unity is needed and it can not possibly eliminate operating malpractice.

In short, if the ARRL leadership would throw in the sponge officially on backing an aggressive campaign to preserve the amateur HF bands the way would immediately be left open for a new group to step in and put on a real campaign.

The alternate to these concepts is to have parallel efforts going on at the same time. Competition is called the life of trade. Perhaps it will provide continued amateur operation on the HF bands after the ITU conferences in 1965 and 1969.

10. What are some of the things that should be considered as elements of a hard hitting campaign? First of all we certainly need a reasonably accurate idea of who is for and who is against amateur radio in all of the 100 odd countries who have a stake in the ITU grab bag (conference).

This will require the assembly of an organization chart of all of the governments concerned showing the relationships and personnel involved in the department sections of the equivalent of our FCC, DOD and State Departments. In most countries these are the Post Office, the military and the Foreign Office. To assemble this data in organization chart form and personnel data in card file form is quite a chore for a good lobbyist to start work on.

By keeping it up to date and contacting the people involved we can maintain an accurate barometer of world opinion. The IARU could help immensely in accumulating this data, but of course they too have to be sold on the idea of helping themselves to maintain our current rights.

11. While much debate can take place in a more or less circular pattern leading nowhere. The Achilles heel insofar as frequency allocation is concerned is that it started out when very little was known about ionospheric radio transmission. Frequencies were allocated pretty much on a grab bag basis and as a result there are serious inefficiencies built into the allocation plan.

This is no secret. Most of the savvy professionals throughout the world know it. They shudder at the thought of reworking it into an efficient plan and up until now there have always been sections of the ham bands to take away from these peace loving dupes.

12. Now the situation is completely changed for the first time since 1927. If all the HF amateur bands are taken away, this will not solve the requirements for point to point and international broadcasting channels by a long shot.

A much greater source of channels lies in the built-in inefficiencies and channel hogging practices of the first countries with their noses in the grab bag. Our own dear Uncle Sam is the biggest hog having 50,000 of the 250,000 channels now assigned on a world wide basis.

Of course we need much more statistical data than this. Of course we must release more of it with the passage of time to every ITU delegate country, to its

people who count after we find out who they are.

For example we need to know how many point to point and short wave broadcasting channels are assigned to each country. How many point to point channels are commercial and how many are exclusively military.

What channel widths are available in each instance so the total band width per country can be calculated.

Unquestionably other data will be heeded as we dig deeper and get more professional minds at work on our side.

We must harp and harp on the inefficiencies and injustices. Further we can and should come up with formulae which will produce an equitable division of channels between countries based upon their actual needs. We can again become LEADERS instead of standing around hat in hand hoping for a handout.

Yes Algernon, we will step on some painful corns both here and abroad. Some people aren't going to like us at all, particularly the dog in the manger types. On the other hand we might make some darned good friends if we show how the "have not" countries can force the disgorgement of unused channels from the "have too much" countries, so there will be an equitable and efficient frequency distribution.

Yes, Algy, there is a lot of work to do and it will take a lot of time and cost a lot of money or we can just sit back and wait until we are moved up to 1200 mc.

Dana Griffen W2AOE

Listen . . . . Fellow Radio Amateur, cont . . .

Dear Wayne,

I know you will permit me a bit of space in 73 Magazine to answer the remarks of K9COG in reference to my article "Listen . . . Fellow Radio Amateur" which appeared in the November issue of your magazine.

I rest my case by quoting a portion of a speech given before the Quarter Century Wireless Association on October 25, 1963, in New York City. The speech was titled "Amateur Radio and Public Service." The speaker was Ivan H. Loucks, W3GD, Chief of the Amateur and Citizens Radio Division, Federal Communimations Commission. This is what Mr. Loucks said:

> "In passing, it might be well to mention that many persons seem to confuse their own personal interests or convenience with that of the public at large. The high incidence of 'problem children' among the Class D station licenses in the Citizens Radio Service is a very glaring example of this, but I am afraid that the attitude is also seeping over into the Amateur ranks. Nothing could prove more fatal to amateur radio, as such, than to have that attitude become dominant. You have heard before, and you will undoubtedly hear again, that amateur radio must justify itself as a 'service'—if it becomes merely a 'hobby' there will be no defense against the other communication services which are continually looking for more frequencies on which to transmit their necessary traffic. Ships, aircraft, international telephone and telegraph circuits, private and governmental users of all kinds and, yes, international broadcasting are all cramped for spectrum space and are very possibly eyeing our amateur bands as a means of relief. It is up to all of us, as dedicated amateurs, to justify our frequency bands and our Amateur Radio Service, on the scales of Public interest, convenience and necessity."

Appliance operators! Take note!

William I. Orr W6SAI

Notes

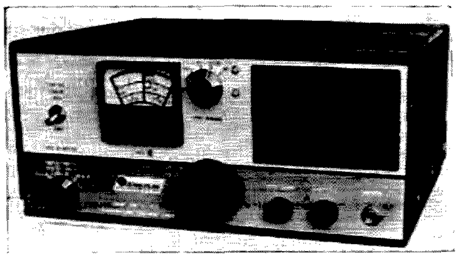
Belgium Rally

Another international mobile rally is being planed for August 1964. This one will be in Ardennes, Belgium and we understand that foreign radio amateurs will be granted a three weeks temporary mobile license. 80 and 2 meters are the bands being planned for.

Tech-Ceiver Improvement

A note from W1UAD points out that he increased the sensitivity of his WRL TC-6A transceiver by substituting a 6DC6 for the 6CB6 rf amplifier. This required a 220 ohm ½ watt cathode resistor bypased with a .001 disc to limit the current through the tube. Jack says it works like a charm.

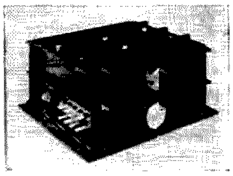
New Products



More Swan

The fellows out at Swan have apparently not been spending all of their time trying to keep up with the orders on their three-bander sideband transceiver. Now they've come up with a little unit that makes the Swan 240 into a full bilateral transceiver. The Swan TCU (Transmitter Control Unit) contains a VFO for the three (20-40-75) bands covered with the 240, a VOX unit with anti-trip, a 100 kc calibrator, a 15 mc channel for WWV reception, and a built-in speaker. The TCU plugs into the 240 and in no way impairs its mobile operation. Either the transceiver or the TCU may be used to control the frequency of the transmitter or receiver, or either can be used to transceive. $115.

Swan has a new ac supply that is designed to fit in the TCU case, resulting in a complete home station in the matching 240 and TCU cabinets. This supply, the SW-117B, sells for $75.

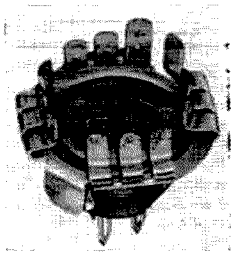


Universal Power Supply

Linear Systems (Adcom) have announced a new power converter which will supply the right voltages for all of the mobile transceivers now on the market. The Linear Century converts 12-15 vdc to 650-850 vdc at 500/400 ma, 250-325 vdc at 200 ma, and 0-120 vdc negative at 20 ma. The output voltage drops only 8% from no load to full load and the operating efficiency is an amazing 91% with 275 watts output. It is short-circuit proof. The Century weighs in at 7 lbs. and is 3½" x 6" x 7". Price is $145. More data? Write Adcom at 605 University, Los Gatos 2, California.

World Radio Catalog

Just in case you have been improvident enough not to be sure you are on the list for WRL's 1964 catalog, you would do well to drop them a card and get this exclusive ham catalog. Free. Write Box 919, Council Bluffs, Iowa 51504.



Nu Nuvistor Socket

The first heat dissipating nuvistor socket is now on the market. They didn't say how much, but if you drop a line to Cinch, 1026 S. Homan Ave., Chicago, Ill., 60624, you may find out.

Letters

Dear Wayne,

Here is a tip for Swan owners. I got tired of dragging a speaker with me every time I took my Swan from the car to the house and mounted one of those transistor portable size 2" x 2½" x 1½" speakers in the left side nestled among the 12AX7 product detector and the XBA6 carrier oscillator. The speaker leads go through the grommet carrying the leads for carrier balance gain and are connected to pins 6 and 12 on the Jones plug.

Dennis McCarthy KØYTI

ATT WAYNE GREEN

After six months of intensive inregestan I have discovered some most interesting facts. Trying to give you a even break for your so called non-profit enterprise would be fair—if you warrented as much! You might want to know, some of your forner reader have turned over to me, documented copys of your letters and, testomials you sent them.

Your derogatary, and rash statements must certainly make your existance more pleasurable, by expressing "DICTATORIAL" ideas. Their must be a great feeling to cancel out anyones subscription, who might not agree with you, our your articials.

A word to you about amateur radio that you must know, "their is no station in life ideas" when we indulge in our hobby. Remember even when off the air working as a groupe or alone, a persons background or, financial status is not to be noticed.

In con clusion to this letter I must add that all reports and letters are in the process of beig turned over to A.R.R.L. for their use. I am not pressing any friction anong any legal operation. I'll let them be the judge and jury.

Knowing that their is no regular letters to the editor collam in "73" magazine, their for I have no real reason to think you'll follow up this letter, ... except with a reply, "OK your no longer able to purchase any item from our supplys"

Signed F.D. Rosnberg **W6NYG**
555 Airport Circle #76
Santa Maria, Calif

(W2NSD from page 4)

be an emergency fund available to help in those cases where there seems a reasonable possibility that a precident might be established which could alter the history of amateur radio.

For instance, if I may digress a moment, there is a case about to come up in California where the City of Santa Barbara has asked the Superior Court for an injunction to stop the operation of amateur stations K6GHU, K6KCI and WA6IBR at their local residence on the grounds that they are a Public Nuisance. This is going to be tried in a local court. If this case goes against us it could spark an avalanche of similar cases all over the country. This is a particularly good case since there are no side issues involved. The FCC has checked the stations and found them clean. This is strictly an attempt by the local authorities to regulate federally licensed transmitters. The Santa Barbara Amateur Radio Club estimates that the defense of this case would probably cost about $1500. Isn't something like this important enough to warrant funds being made available by the Institute?

4) On the international scene there also is important work to be done. The Institute could set up an international mailing list of all foreign government officials who have any influence on amateur radio in their country or who are likely to be members of a delegation at the next Geneva Conference and keep a supply of information about amateur radio going to them.

(Turn page)

We have an important story to tell of the value of amateur radio in the U. S. and we should be able to help amateurs in other countries by making our story known world-wide. Further, we can meet these officials personally and try to help them with their problems. Newer countries may need a hand in establishing an amateur service and our representatives can not only provide answers to all questions, but can undoubtedly make arrangements to provide a good deal of equipment donated by interested U. S. amateurs and manufacturers.

A world-wide amateur study of the occupancy of the commercial bands would undoubtedly give us valuable ammunition to counter the demands for amateur frequencies at Geneva. Something like this must be done by a large organization.

5) Through the pages of 73 we can encourage amateurs to bend every possible effort to improve their image and step up their work in public service. We need a program emphasizing on-the-air manners, courtesy, politeness, consideration and responsibility.

This means we need a lot of members of the Institute. This in turn means that *you* are needed not only to support the Institute with your membership dues, but that your help is needed to get as many other fellows as possible to join in this battle for our survival. This has to be talked up on the air, at clubs, and everywhere that amateurs get together. Here is an opportunity for every amateur to stand up and be counted.

We will send a beautiful Institute of Amateur Radio Membership Certificate suitable for framing as well as an attractive membership card to all new members. Charter and present members will receive the new membership cards and certificate by sending their present card with $9.00 to the Institute. This card will be returned.

Send your name, call, address and $10.00 to the Institute of Amateur Radio, Peterborough, New Hampshire. Please send it quickly so we can get our program started.

ARRL

How will the sudden expansion of the Institute of Amateur Radio affect the ARRL? Well, you can bet that it will startle the Executive Committee and Directors. It may even occur to them that they have erred in dismissing the pleas of Dana Griffin W2AOE and many others who took the time to write to them and suggest that the ARRL step in and do something to keep our hobby going. They may wish that they had heeded my past

editorials suggesting action instead of unending deliberation. I'm sure that the Institute will make them a lot more sensitive to the feelings of their members. It may also spur the League into more action and less talk about improving amateur radio. I don't see any area where amateur radio will do anything but benefit from a strong Institute.

73 can, I believe, do a lot to bring the ARRL back to life. We're going to really try for I feel that the ARRL is very necessary to amateur radio. One of the great problems that has beset the League is the censorship which seems to have been a fixed rule in QST. This has made it virtually impossible for the members to get anything except the "official" side of any matter. 73, I think we have adequately demonstrated, can fill in this gap by making every attempt to cover both sides of all issues. One serious weak point in the ARRL makeup has been the dearth of information available for the members to use in making up their minds about who to vote for at Director voting time. The little card which accompanies each ballot seems to many to be heavily weighted and there is a strong feeling that the publishing of fuller information on all candidates would be helpful. This is an area where 73 can probably help the ARRL back to health.

I'm sure that many of the past directors have a lot of good ideas which might further benefit both the ARRL and our hobby. I'd like to hear from them and anyone else interested.

About 73

Visitors here at 73 headquarters are almost always astounded to find that I haven't been kidding about how we are putting out the magazine. Our offices fill several rooms of a 170 year old New England mansion and we have at the moment six hams living with us and working on the magazine. Most of them put in about twelve hours a day at work and the salaries vary from $30 to $60 a week.

To say that I have my hands full is an understatement. Hams, as you well know, are not normal people and our ham collection here is no exception. Some do a marvelous job, others make me wonder if it wouldn't be better to wave goodbye and do their job myself, thereby saving me considerable time. I find that editing and publishing 73 takes just about full time for me and by the time I have added in the demands of the Radio Bookshop, the many 73 Products, our Kits, the Tours, management of our house and grounds, our vast collection of pets and livestock. our daughter Tully, 6UP, the Porsche and VW

busses, ad infinitum, I can see why I have been so reluctant to increase the scope of the Institute of Amateur Radio.

I have given this a lot of thought, trying to figure some way to do what I know has to be done to keep ham radio going, and the only possibility seems to be for me to expand the Institute and get things started. You can't imagine how much I wish that the ARRL would shoulder these responsibilities, leaving me to gradually build up 73. Then I ask myself, "build up 73 for what?" What will be the need of 73 if ham radio ceases to exist?

Though 73 really can't afford it as yet, I'm going to go out on a limb and hire two or three more amateurs to take over many of my responsibilities so I can work hard to get the Institute of Amateur Radio set up as a truly democratic club and start the most important immediate functions going.

Time is our worst enemy. I'm counting on you to join the Institute of Amateur Radio, Inc. (a non-profit corporation), and look deeply within yourself to see how much you love amateur radio and how much you are willing to give of yourself to keep our wonderful hobby (service) alive. Can you get others to join? Can you devote some time to work in your area?

I expect that my motives will be questioned . . . I'm used to that. What is this guy Green really after? He wants to get rich! He wants power! No, mostly I want to be of some value to the world before I leave it. I've chosen the field of amateur radio because it is one that I dearly love. Those of you who have visited our place probably understand. Let me quote from a piece by Doug DeMaw W8HHS out of the September issue of the VHFR ($2 a year), which he publishes. "The trip would not have been complete without a visit to '73 Acres' in Peterborough, N. H. Never before have we been greeted with such hospitality and friendliness. No one should sojourn through N. H. without meeting this decidated man, his wife and staff who have completely thrown themselves into the cause of improved amateur radio conditions. We enjoyed our overnight stay at W2NSD. A personally prepared waffle breakfast by the 'ed' himself, with New Hampshire pure maple syrup and all the trimmings and garnished with a vigorous discussion related to the controversial matters of the day (which are destined to affect all ham radio operators) was very invigorating. For many months I tried to understand this man Green's motives and his attacks on other publishers and organizations, but until I met this guy face to face, I could not properly evaluate his thoughts. I am convinced through seeing the results of his publishing house efforts, listening to his explanation of his convictions and hearing him relate his hopes for the ham fraternity and its future, that he is neither vindictive nor radical. He believes in what he is doing and is willing to fight for those who share his beliefs."

Geneva will be upon us before we know it. The next conference could come anytime between 1965 and 1970, with the educated money riding on 1967. This gives us precious little time to prepare. It is important that we get right at the work that has to be done and do it now, this year. By 1967 we can have the story of amateur radio known by every delegate at Geneva and every official with authority in the field back in the home country. We may be able not only to make these people friends of amateur radio, but may, even in that short time, be able to start an increase in the number of DX amateurs.

OK? Can we get started? That's Institute of Amateur Radio, Peterborough, New Hampshire. $10.

Rumors, Rumors

It is only natural, I suppose, for a lot of silly rumors to be circulated when something as controversial as RM499 is demanding attention. One of the strangest I've heard so far suggests that the whole incentive licensing bit, complete with the petition to the FCC, is a plot by a manufacturer to introduce a temporary depression in the amateur equipment industry to force most of the smaller manufacturers who don't have sizeable military and other production out of business so they will have clearer sailing later on when things perk up again.

Even though this would answer several otherwise difficult to answer questions, it is much too far fetched to consider seriously.

Good Reading

While the fellows who pushed the Executive Committee of the ARRL into okaying the petition are waiting for the FCC to make a decision on RM-499 they might find it interesting to pull out a September 1962 issue of QST, turn to page 65 and read #4 paragraph. This is an interesting decision from the FCC in answer to a chap who suggested that amateurs have to pass a special microwave exam before they could operate on 220 mc and above. The FCC had this to say regarding their decision not to adopt the proposal: "(1) The

bulk of the licensed amateurs, excluding Novice and Technician classes, are now authorized all amateur operating priviliges. Many have a considerable investment in equipment for operation, not only in the 220-250 mc/s band, but also in higher bands. Such a restriction would, in many cases, result in an unwarranted financial loss on this equipment as well as a dimunition of operating privileges. (2) Many General Class amateurs, as well as the former Class A and Advanced Class holders, have held their licenses for many years, and it does not appear reasonable now to require them to be examined in order to use privileges which they have previously been authorized to use."

The Board of Directors may find that interesting too for it certainly is a strong precident that the Executive Committee, which the Directors set up in its present throne of power, is trying to buck. Or did anyone bother to read this musty-dusty old FCC decision before charging ahead?

Our Image

The ruckus stirred up by the ARRL has done one good thing . . . it got Bill Orr to tell us how rotten we are and this in turn got a lot of fellows worrying about what to do about it before the ARRL tries to get the FCC to

pass laws against being rotten.

Even I've been thinking, and those of you that have the courage to frequent this obscure section of 73 with any regularity know that this can not possibly mean anything but watch out.

I think that we can clean house all by ourserves without daddy standing over us with a big stick. We can de-rotten ourselves by screwing up the courage of our convictions, planting our tongue firmly in our cheek and stumbling ahead blindly. Or, if you want a de-metaphorized translation of that, when you hear an ass on the air get on there and bray at him.

There is always a great danger of seriousness setting in. When a fellow pulls a blunder he is very likely to get mad when informed. It is a lot easier to get mad at someone who is correcting you than to admit, even to yourself, that you did something stupid. I suggest that amateurs who are forced by a poor childhood into taking everything seriously go about their regular operating business and leave the band cleaning up to those with a more mature outlook.

How then should we go about clobbering offenders? I expect we'll get better results by joshing them about their blunders than by reprimanding. All of us hear the occasional bursts of insanity and childishness on our bands, we just haven't taken it upon ourselves to step in and do something about it. Isn't it about time that we faced ourselves and shouldered some responsibility for the way things are? After all, it isn't so much the fellows who are making the mistakes that are in the wrong as it is us who hear them and don't speak up.

To sugar coat the reprimands a bit we might use a reporting system on the order of RST. This might be on the OPU (Operating procedure, unrecommended) scale of 0-9. Long CQ's might rate an OPU-5 report. "Break-Break-Break" could get OPU-6, with additional points for each two additional breaks. Inexcusable language could get as high as OPU-9. Calling CQ without checking the frequency certainly would be on the order of OPU-7, unless there is a net on the channel, which would increase the report to an 8. Over-long transmissions could get an OPU-3. Etc.

There has been considerable warning about what our do-gooders should call themselves. The word "Police" is definitely frowned upon. "Official" is too strong. I say let's call a club a club and form the OGPU, the Official Gestapo Police Vigilantes (libraries use V's for U's, so let's even things up). If you feel that

you need even more authorization, you can identify yourself with OGPU plus your zip number. Oh, don't forget to include your FCC call or else you'll rate an OPU-4 report yourself. OPU-3 at least if you get serious about reprimands.

OK, all OGPU'ers get in there and pitch.

If it will be any help we will publish an Official List of OPU points as suggested by OGPU'ers.

Scrounge Dept.

Having just invested in a final designed to work with 4-400's and not having any 4-400's, I'm wondering if any readers might have a used one, perhaps from a BC rig, which would have some spirit left and still be reasonable.

Sideband Dinner

Just about everyone who is anyone, to coin a phrase, makes it a point not to miss the yearly Sideband Dinner in New York at the time of the I.E.E.E. show. It will be held Tuesday March 24th at the Statler-Hilton Hotel, 33rd Street and 7th Avenue. Equipment displays open at noon and the buffet style dinner starts at 7:30 PM. Tickets are $10 each. Order from W2JKN, 4665 Iselin Ave., New York 71, N. Y.

. . . Wayne

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... $20.00

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a Zener diode. Kit includes even the battery and mini-box. See page 15, Aug. '63.
K9ONT $5.00

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included. See Aug. 62 p 38.
W2LLZ $13.00

RECEIVER-DECEIVER. Substitute local oscillator for your receiver for sideband reception, complete with power supply, tubes, voltage regulator, etc.
W2RWJ $19.95

HAM BAND AUTOMOBILE CONVERTER. Listen to the hambands instead of that rocky-roll junk. Transistor converter, complete with battery, etc., to tune 20 meter band. Crystal controlled.
VE2AUB $6.95

WRETCHED K2PMM

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ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

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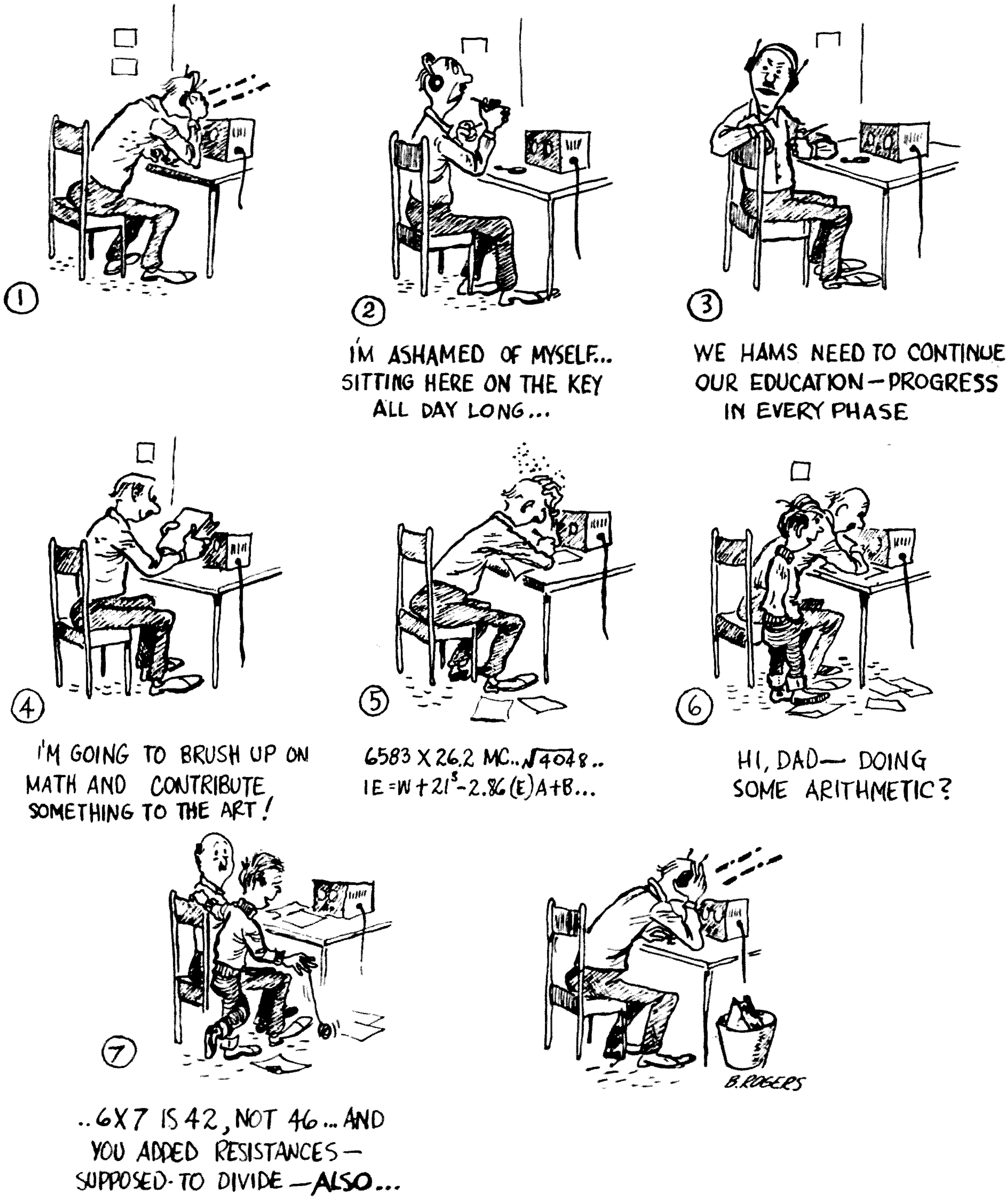

1
2
I'M ASHAMED OF MYSELF...
SITTING HERE ON THE KEY
ALL DAY LONG...
3
WE HAMS NEED TO CONTINUE
OUR EDUCATION—PROGRESS
IN EVERY PHASE
4
I'M GOING TO BRUSH UP ON
MATH AND CONTRIBUTE
SOMETHING TO THE ART!
5
6583 X 26.2 MC.. √4048..
IE = W + 21³ - 2.86(E)A+B...
6
HI, DAD— DOING
SOME ARITHMETIC?
7
..6X7 IS 42, NOT 46... AND
YOU ADDED RESISTANCES—
SUPPOSED-TO DIVIDE—ALSO...
B. ROGERS

Propagation Charts

J. H. Nelson

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	7	7	7	7	7	3.5	7	7	7*	14	14	7*
ARGENTINA	14	7	7	7	7	7	14	21	21	21	21*	21
AUSTRALIA	14	7*	7	7	7	7	7	14	7*	7	14	14*
CANAL ZONE	14	7	7	7	7	7	14	14	21	21	21	21
ENGLAND	7	7	7	3.5	3.5	7	14	14	14	14	7*	7
HAWAII	14	7	7	7	7	7	7	7	7*	14	14*	14
INDIA	7	7	7	7	3.5	3.5	7*	14	7*	7	7	7
JAPAN	7*	7	7	7	3.5	3.5	7	7	7	7	7	14
MEXICO	14	7	7	7	7	7	7	14	14	21	21	21
PHILIPPINES	7*	7	7	7	7	3.5	7	7	7	7	7	7
PUERTO RICO	7	7	7	7	7	7	14	14	14*	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	14	21	21	21	21	14
U.S.S.R.	7	7	7	3.5	3.5	3.5	7*	14	14	7	7	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	14	7	7	7	7	7	7	14	21	21	21	21*
AUSTRALIA	21	14	7	7	7	7	7	7	7*	7	14	21
CANAL ZONE	14	7	7	7	7	7	7	14	21	21	21	21
ENGLAND	7	7	7	3.5	3.5	7	7	14	14	14	7	7
HAWAII	14	14	7	7	7	7	7	7	7*	14	14	21
INDIA	7	7	7	7	3.5	3.5	7	7*	7*	7	7	7
JAPAN	14	7*	7	7	7	7	7	7	7	7	7	14
MEXICO	14	7	7	7	7	7	7	7*	14	14	14	14
PHILIPPINES	14	7*	7	7	7	7	7	7	7	7	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	21	21	14
SOUTH AFRICA	7*	7	7	7	7	7	7*	14	14	14	14	14
U.S.S.R.	7	7	7	3.5	3.5	3.5	7	7*	7*	7	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	3.5	3.5	3.5	3.5	3.5	7	7	14	14
ARGENTINA	21	14	7	7	7	7	7	14	14*	21	21	21*
AUSTRALIA	21*	21	14	7	7	7	7	7	7*	7	14	21
CANAL ZONE	14	7*	7	7	7	7	7	14	14*	21	21	21
ENGLAND	7	7	7	3.5	3.5	3.5	7	7	14	7*	7	7
HAWAII	21	14	14	7	7	7	7	7	7	14	14*	21
INDIA	7	14	7	7	7	7	7	7	7*	7	7	7
JAPAN	14	14	7*	7	7	7	7	7	7	7	7	14
MEXICO	14	7*	7	7	7	7	7	7	14	14	14*	14*
PHILIPPINES	14	14	14	7	7	7	7	7	7	7	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	21	21	14
SOUTH AFRICA	14	7	7	7	7	7	7	7*	14	14*	14	14
U.S.S.R.	7	7	7	3.5	7	3.5	7	7	7*	7	7	7

***Means next highest frequency might be useful.**

Good: 6-9, 19-23
Fair: 1, 10-14, 18, 24-25, 28-29
Poor: 2-5, 15-17, 26-27

73 Amateur Radio

March 1964
Same Old 40c

GENEVA IN 1965?

Frequency re-allocations are coming sooner than we thought possible. We are not prepared.

FCC DOCKET DUE IN MARCH

The FCC's answer to ARRL's RM-499 should be out this month. Keep your fingers crossed.

ARRL LOSES VOTE

The results of last months cover ballot show 83 1/2 per cent of the amateurs opposed to RM-499.

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

March, 1964

Vol. XVII, No. —1

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Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire.

What is the ARRL?

Who is the ARRL?

What does the ARRL do?

What should it do?

There are still a few fellows who have either skimmed over my editorials or just not read them at all, that feel that I have been attacking the ARRL and perhaps want to put them out of business. I do wish these nit wits would take a little time off from flapping their mouth to run their eyeballs over my editorials and make themselves aware of the adulterated hogwash they are putting out.

Now, to the ARRL. Have you ever given much thought to what the ARRL actually is? Let's take a look at it.

The primary activity of the ARRL is to publish QST, the Handbook and other assorted publications. As a publishing house it is quite successful. The League also provides a wide range of services to the amateurs such as managing the QSL Bureau, issuing cartificates, maintaining the Honor Roll, BPL, distributing films to clubs, running W1AW, sending out messages through the Official Broadcast Stations, etc.

The League employs a counsel to aid it in submitting proposals to the FCC and to provide legal references for lawyers representing amateurs who are having difficulties tied in with amateur radio.

The League is supposed to be run by the Board of Directors. Unfortunately the Board gets together only once a year and each Director is only in office for two years unless he is re-elected. This means that each Director can look forward with confidence to but two meetings. This is an extremely weak point in the makeup of the League and may be largely responsible for the lack of representation felt by many members.

de

W2NSD/1

never say die

The directors decide upon the president and vice president. Unfortunately this process has been carried out at secret pre-board meetings by the Directors and the real facts entering into the selection of these officers have been kept hidden. Since the president can be dismissed by the directors without appeal to the members he has little power and historically has been merely a figurehead.

Who then actually runs the League? Let's look further. Let's take a look back into history.

The ARRL was set up by Hiram Percy Maxim. Maxim was a genius, by the way, and he set up the League very cleverly. The elections of the directors gave the members the feeling of participation and permitted the drawing of broad parallels with the U. S. government setup and looked at first glance like a democracy. But Maxim kept a tight hand on the reins and never let his "democracy" get out of control. We call this a dictatorship today. Many dictatorships work out very well as long as the dictator is benevolent. The problem always comes up: when the dictator dies, where do we find another benevolent dictator. The normal system is for the power to fall into the hands of an underling who has worked himself up with just that power in mind.

K. B. Warner replaced Mr. Maxim. I wasn't in a position to know what was going on on the inside in those days, but I do note grumbles and complaints still with us from those years in letters from old timers who were in a position to know.

Budlong was in the driver's seat when I began to become aware of the world of amateur radio politics. Discontent reached an all-time high under Budlong and the League's stature reached the low point which brought on Docket 9295, the FCC proposal which virtually ended the League's representation of the amateur before the FCC. Budlong was the Editor of QST and the Secretary of the League.

The system for getting favorable directors

re-elected seemed to be worked out to about perfection and though I believed that amateur radio would be the winner if Bud were replaced, it took a while before the opportunity came along to help. Eventually it did and in a short while Bud's retirement was announced.

The vacuum created brought on an interesting power play among some of the directors. This was largely responsible for the unsettling events of the last year which culminated with the secret submission of RM-499 to the FCC. This, as our poll and the response to the FCC has shown, has been immensely unpopular and the tidalwave of resentment which has resulted seems about to bring on another shuffle. Rumors from responsible sources tell us that Hoover, having learned what he has gotten himself into, will shortly tender his resignation. There is some question in my mind about how much influence commercial interests may be able to exert to prevent this from happening.

Which brings us down to today. When amateurs write in and tell me that everything is going to be OK, that the ARRL has been leading us for fifty years and we should all put our support behind the League, I wonder what they think the League is? Who are they supporting? What policies? Whose policies?

Who is in charge today? Hoover? Huntoon? Handy? Houghton?

I don't think so.

When Mort Kahn W2KR (K4KR) was elected as a director I expected him to end up as Secretary of the League in short order. He no doubt could have, but instead he organized the directors and masterminded everything through his position on the Executive Committee. This left the burden of the administrative details in Huntoon's hands and the reins in Kahn's. Mort was, I believe, largely responsible for the decision to move to a new headquarters, to build a new headquarters building, and to get the members to donate to the building fund. He also seems to be deeply involved with the incentive licensing hassle and the RM-499 petition.

If Mort follows through on his reported decision to not seek re-election as Hudson Director this will throw the ball back up in the air again. Mort seems to be pretty happy now that he has moved, yacht and all, down to Florida so it is possible that he will wave goodbye to the tumult and responsibility of amateur politics.

Perhaps you think I'm all wet. You can find out about much of this if you contact any

(Turn to page 78)

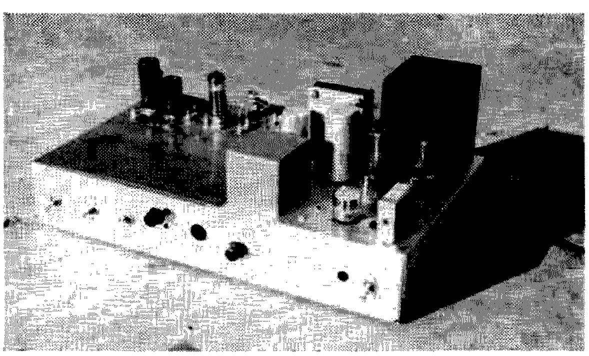
The Little Punch on VHF

Jim Kyle K5JKX
Jim Speck W5PPE

The requirement—a good rig for VHF use, with minimum cash outlay for a top-notch signal.

The result—a little puncher with measured 84-percent efficiency (!), incorporating rf sections, modulator, and power supply all on a 10x17x3 chassis. Though the signal rivals that of much larger rigs, it takes only 25 watts of dc input to the final. It incorporates audio clipping and filtering, with up to 30 db of clipping available when conditions warrant. It also includes all control circuitry for the complete station. Interested? Read on.

First let's talk about that 84-percent figure. We don't really believe it either, but the calibrated instruments we checked it out with showed 25 watts in, 26 watts forward power, and 5 watts reflected. This means a net power output of 21 watts for 25 in, or 84 percent efficiency. Actually, we think that the calibration tolerances sort of all added up together to give this figure, and the true efficiency is probably somewhere about 75 percent—but this is still a whale of a lot higher than the 55-60 percent usually considered acceptable at 144 mc and above.



Complete transmitter, fully assembled. Vacant space on rf module will be occupied by 432 mc tripler, to be added soon. Details on it after it's in use.

The whole thing started one warm night when co-author W5PPE asked K5JKX, "Why aren't you on two?"

Answered the other Jim, "No rig."

"How's your junk box?" asked Speck.

"Let's go look," said Kyle, and that was the beginning.

A comprehensive search of the garage (one huge junkbox) yielded a 250 volt plate transformer of unknown vintage, a 10x17x3 chassis somewhat resembling a chunk of swiss cheese, a 20 watt modulation transformer salvaged from Collins surplus, a 6 amp 6 volt filament transformer, a couple of 800PIV silicon diodes, and miscellaneous small items, including a large sheet of perforated brass.

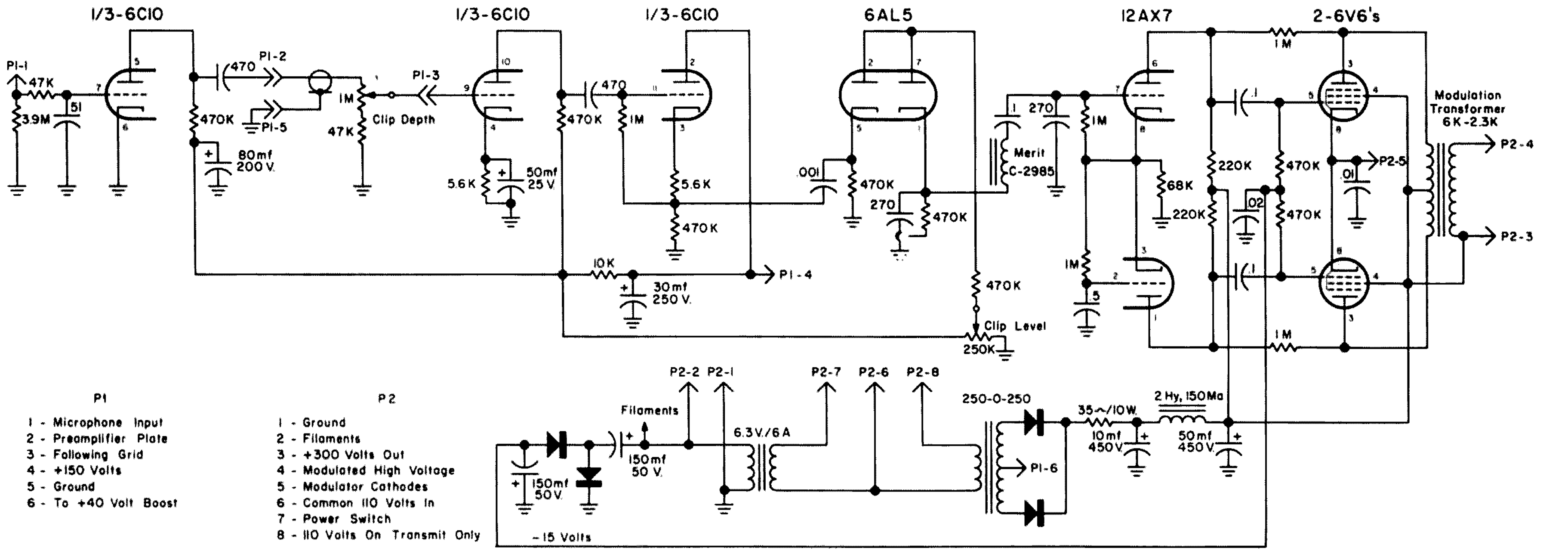
The search then moved to the W5PPE QTH, where most of the remaining parts (including the 6360) were located.

Upon looking at the mutilated chassis, the thought struck. Why not make it a "modular" rig, so that everything could be built on plates separate from the chassis and plugged in. This was done, and has worked out nicely.

At the starting point, the rig was divided into three major modules: rf deck, modulator/power supply, and control circuits. The control circuits were built into the chassis. The rf deck was built on the sheet brass, and the audio/power module was assembled on a sheet of structural-grade aluminum which came to light along the way.

Notes on Figs. 1 and 2

L1C1, L2C2—resonate at 24 mc coil forms Miller 4300 red core
L3C3, L4C4—resonate at 72 mc coils on Miller 4300 white core
L5—3 turns Airdux 608
L6—2 turns Airdux 608
C5, C6—15 pf min. butterfly
L7—Line, 6" long 1" wide #12 wire
C7—dual 8 pf Bud variable
C8—½-4 pf piston trimmer



P1

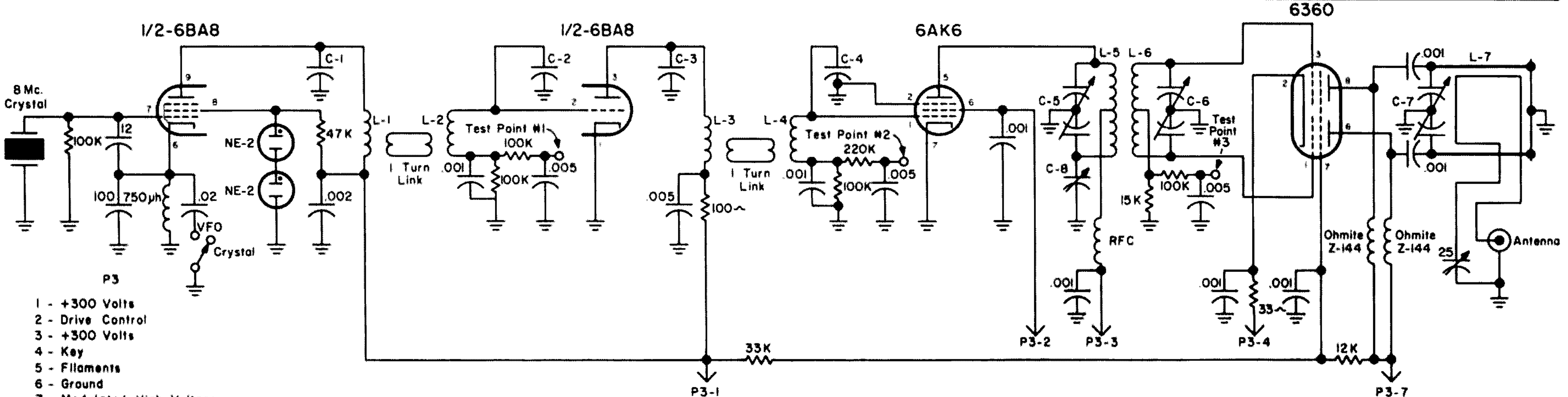
1 - Microphone Input
2 - Preamplifier Plate
3 - Following Grid
4 - +150 Volts
5 - Ground
6 - To +40 Volt Boost

P2

1 - Ground
2 - Filaments
3 - +300 Volts Out
4 - Modulated High Voltage
5 - Modulator Cathodes
6 - Common 110 Volts In
7 - Power Switch
8 - 110 Volts On Transmit Only

AUDIO/POWER MODULE, SCHEMATIC DIAGRAM

FIGURE 1

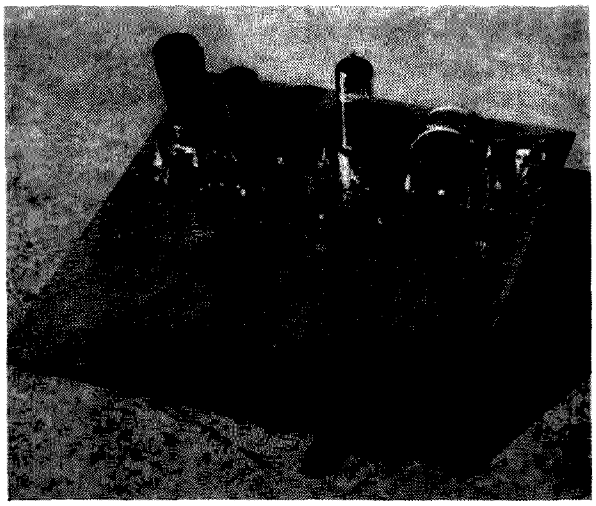


P3

1 - +300 Volts
2 - Drive Control
3 - +300 Volts
4 - Key
5 - Filaments
6 - Ground
7 - Modulated High Voltage
8 - No Connection

R.F. DECK, SCHEMATIC DIAGRAM

FIGURE 2



Top view of rf module showing details of high-efficiency plate line and fanning wire.

Original plan was for Speck to build the rf, Kyle the audio/power, and both to work on the control portion. The design was carried out on this plan, but somehow it all ended up getting built by Speck! In return, the work of writing it up fell to Kyle—so send your complaints to him.

First came the audio/power portion; the schematic for this appears in Fig. 1. It's largely conventional, but has a few unusual points here and there. One is the use of a 6C10 Compactron triple-triode as the preamplifier. At first, all three triodes were used as amplifiers, but distortion was extreme. Changing the third section to a cathode-follower so that the clipper would be driven from a low-impedance source cured this problem.

Originally, also, the 6C10 plate supply came from the 250 volt power supply in the same module, through a hefty dropping resistor/bleeder combination. However, with this hookup the audio took 5 seconds to come on at the start of each transmission; apparently the decoupling-filter time constant was way too long. Rather than change resistors, the lead to pin 4 of plug No. 1 was added, to steal power for the preamplifier from the receiver power supply located in the control section.

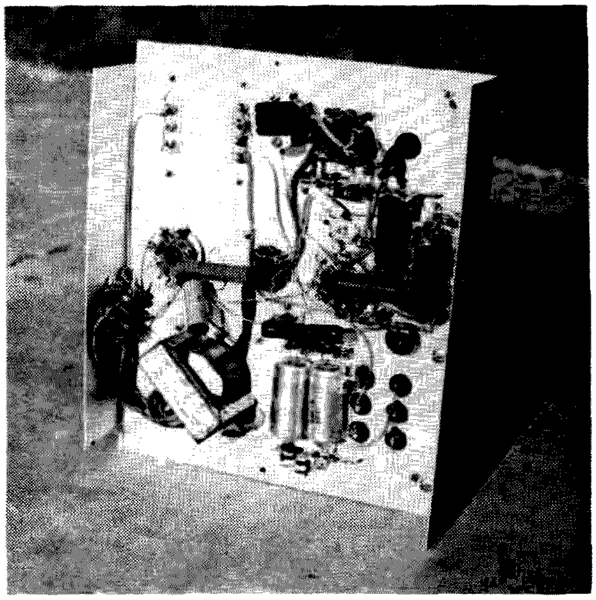
Note the clipping depth control (1 meg pot) between the first two sections of the 6C10. This is located on the front panel, and by rights should appear in Fig. 3; however, since it's such an integral part of the preamp it is shown here instead. The 47K resistor from the bottom of the pot to ground allows the control to be turned all the way "off" to remove clipping, without killing the audio. With the control all the way "on" and a high-output ceramic mike, you'll get about 30 db of clipping. The local gang seems to like it best with the pot about halfway open, which is approximately 10 db.

The grid-return and biasing arrangement on the cathode follower might have been a bit different had this not been the result of a late modification as mentioned earlier. We simply lifted the ground end of the cathode resistor and the grid return to a tie point, then took the plate-load resistor and moved it from the plate circuit to go between this tie point and ground. It seems to work nicely, with no particular pains taken to optimize the cathode-follower design.

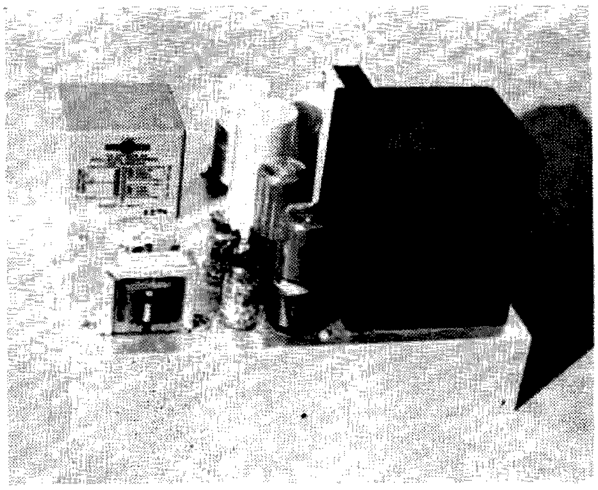
The cathode follower feeds a rather conventional 6AL5 dual-diode peak clipper; clipping level is set by the 250K pot from the most-filtered dc source to ground. We used a subminature pot because we had it on hand; any kind will do nicely as there is virtually no power dissipated here. No bypass is necessary because the 47K resistor to the plates isolates them and the dc line is filtered rather heavily.

The clipper feeds a low-pass filter which was taken from the ARRL handbook almost without change. The Merit C-2985 is a 20-henry, 15 ma choke, and we have used it many times in this circuit; no substitution can be guaranteed. Using the 270 mmfd mica capacitors shown gives a cutoff frequency of 2500 cps, which is about right for natural balance. The low frequency components have already been trimmed back by the 500 mmfd/1 meg grid capacitor/resistor combinations in the 6C10 stages.

Following the filter is the phase splitter;



Bottom view of audio/power module, showing nothing in particular except general layout we used.



Top view of audio/power module. Small gadget between the two miniature tubes is shaft and lock-nut of clipping-level potentiometer.

rather than using a driver transformer or any of the more common inverter circuits we picked the "long-tailed pair." This circuit is slightly rare in ham use but finds frequent application in hi-fi; it has less gain than some other arrangements but can handle higher voltages with less distortion.

In the long-tailed pair, a high-mu tube such as the 12AX7 is essential. One half acts as a combination conventional amplifier and as a cathode follower; the other half is a grounded-grid amplifier driven by the cathode follower. A high degree of negative feedback is inherent in the circuit, as is automatic balancing so that the output voltages are exactly equal and precisely 180° out of phase. Although it has only half the gain of some other circuits, the auto-balance feature and low distortion more than make up for it.

The long-tailed pair drive the 6V6 modulator tubes directly, through 0.1 mfd capacitors. The 6V6's operate in class AB1, with 15 volts fixed bias which is obtained from a voltage-doubler tied to the filament supply line. We used Lafayette SP-137 200 volt diodes for this and the other low-voltage power supplies, but any equivalent type should work nicely.

An unusual feature in the modulator is the use of feedback taken from each plate back to the 12AX7 plates; this is the purpose of those 1 megohm resistors. They give about 10 percent negative feedback, which reduces the amount of tilt present on the clipped tops of the audio. Without the feedback, the waveform looked more triangular than square because of the small modulation transformer; with the feedback, audio quality is excellent.

The modulator cathodes are taken through pin 5 of plug 2 to the control circuitry, where they are grounded in the "fone" position of the mode switch and opened when on CW.

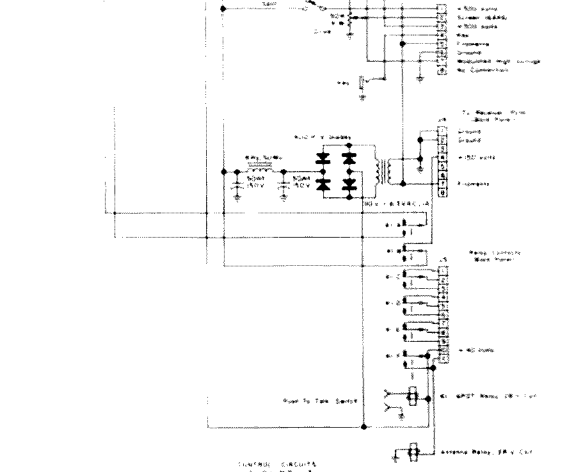
The power supply is more conventional; it uses a 250 volt transformer and 800-PIV diodes in the conventional full-wave hookup. Rather than grounding the center-tap of the transformer, it is taken through pin 6 of plug 1 to the relay-power supply for 40 volts of boost; we found this necessary with the small unidentified surplus transformer we used. It probably should not be necessary with a transformer of fully adequate ratings.

The current-limiting resistor is a necessity, and the 10 watt rating is also needed; a 33 ohm 2-watter burned up with a bright flash, because of the high capacitance in the filters and the heavy load current.

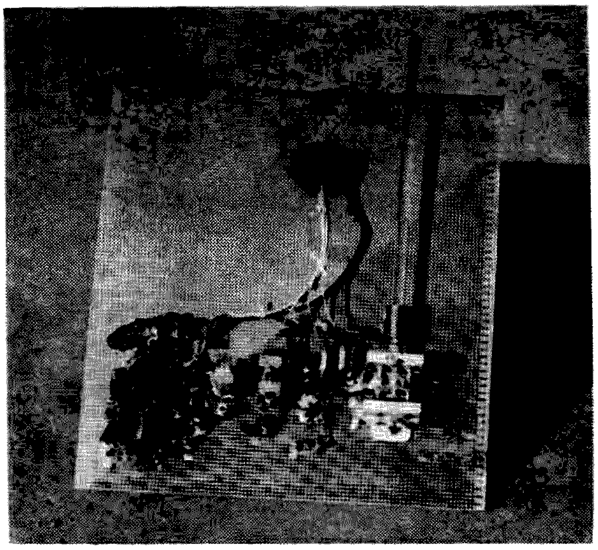
All power for the transmitter is brought out to plug 2, an octal connector on the subchassis flange, while the connections for the front-panel controls and mike jack come to plug 1, a 6-prong Jones type. Thus by unplugging these two connectors, the entire audio/power unit can be removed from the chassis for service or modification.

With this module out of the way, the rf deck came next. This uses a 6BA8 oscillator/multiplier driving a 6AK6 doubler which in turn drives a 6360 straight through as the final.

The 6BA8's pentode section is a conventional harmonic Colpitts oscillator using 8 mc rocks. The switch in the cathode allows use with



CONTROL CIRCUITS
FIGURE 3



Bottom view of rf deck showing compact construction, coupling of stages, and neutralization of 6360 at socket. Tuning-tool extension on plate capacitor shaft is temporary only; shaft will eventually gang-tune with 50 mc rig to be added in blank space to the front.

a VFO if desired. The two NE-2's regulate the screen voltage at approximately 120, to hold frequency stability and avoid "yoops" at the start of each transmission—and they do their job excellently. Adjustment of LI and L2 is facilitated by TP—1 in the triode grid circuit; either a VTVM or a low-range milliameter can be plugged in here and the oscillator adjustments peaked.

The triode section is a tripler from 24 to 72 mc, rather than the more usual doubler. We wanted maximum efficiency in the driver stage so decided to double there instead of here.

TP-2 is for peaking of L3 and L4. Coils LI and L2 are wound on J. W. Miller type 43oo forms, with red cores, while L3 and L4 are on the same forms but using white cores.

The grid circuits may appear a bit unusual; we felt that overall efficiency would be a bit better if the bypass was put at the cold end of the coil rather than in the hot lead between coil and grid as is the more common custom. The results seem to bear out this contention; drive is adequate, even with only three tubes.

The 6AK6 doubles from 72 to 144 mc, to drive the final straight through. This tube may surprise you a bit. Though rated only for audio service with a maximum of 180 volts on either plate or screen, it's a real VHF powerhouse at 300 to 400 volts. Previously, we had tested the 6AK6 on 50 mc with 400 volts on both plate and screen, with power applied for 24 hours consecutively (into dummy load). Output at the end of the test was the same as at the beginning—7 watts. And though the screen was glowing white all the time, it showed no signs of giving up. But one warning—even with the heat dissipating shield we used, the bottle gets HOT. Don't even try to touch it until it cools off after use.

The plate circuit of the 6AK6 merits mention. It's of the balanced variety, mainly to allow direct inductive coupling to the 6360 grid without using standoffs. The piston trimmer serves to balance out the output capacitance of the 6AK6, but seems to make little difference. TP-3 in the 6360 grid circuit is used to peak C5, C6, and C8. It should give a reading of approximately 50 volts with a VTVM in use.

The 6360 has a number of unusual features; most unique is its grounded-line plate circuit. Rather than using the conventional series-fed tuned line, we used shunt feed with a Z-144 rf choke in each plate lead, and a .001 capacitor from plate to line. This removed dc high voltage from the exposed lines, allowed use of smaller spacing in the tuning capacitor, and permitted us to ground the cold end of the line without worrying about a high-current bypass capacitor. It also led to the amazing efficiency, but more about this later.

Before getting to the plate circuit, though, let's look at the rest of the stage. The grid circuit, you'll notice from Fig. 2, has no bypass capacitor. This allows the tank to reach its own capacative balance so that each half of the tube contributes equally to the output. Present but not shown in the schematic are neutralizing wires, although the 6360 is supposed to have built-in neutralization. We found that in this rig, it is *over* neutralized, so we had to do some work at the socket. The neutralizing wires consist of ¾ inch lengths of bare hookup wire soldered to each plate pin (6 and 8), crossed over but not touching at the center of the socket, and spaced about 3/8 inch from the grid pins (1 and 3).

Neither is there a screen bypass capacitor; this one is built into the tube also, and it works nicely. Don't put on an external one or things won't work right.

Another unusual point in the screen circuit is the 12K-33K bleeder from modulated high-voltage to the unmodulated 300 volt supply, with the screen supply taken off at the tap.

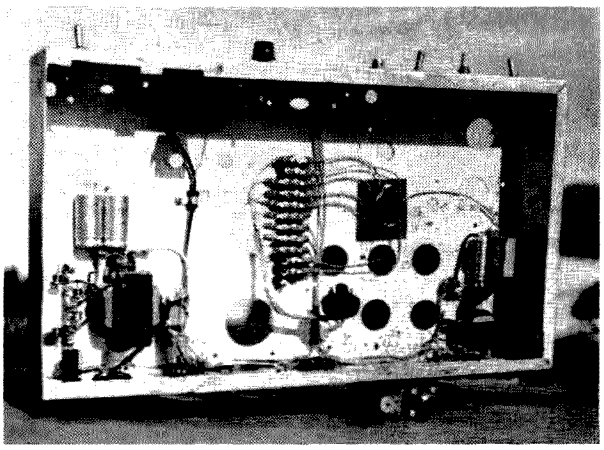
This came directly from the manufacturer's poopsheet (Amperex) and sets the proper percentage of screen modulation for good linearity; this is about 65 percent if the plate is modulated 100 percent. The large output capacitor in the 300-volt supply on the audio/power module keeps any of the modulation

from getting back to earlier stages of the rf deck.

All stages are inductively coupled or double-tuned with 1-turn coupling links. This makes for minimum TVI and maximum transfer of energy on the desired frequencies only. The rig has been operated less than 5 feet from a TV set which was tuned to a deep-fringe signal on Channel 5; no trace of TVI resulted. And this without any shielding on the top!

Now back to the 6360 plate circuit and that efficiency. After the rig was put together and we were turning it up the first time, we found that touching the plate line with a screwdriver at one point would more than double the power output indicated on the meter, with no change in plate input. This led to experiments with a wire soldered to the ground plate and bent near the line for capacity balancing. No good. But when the wire was moved out about half an inch from the line-to-plate junction, and then connected directly to the line part way up, we quickly found that at several points we could get the high efficiency again. That's why the wire seen in the top view is there, and that's how we got the efficiency. Though we haven't figured out yet just exactly what's happening we believe that the "fanning out" of the line raises the amount of current flowing at the ground end near the link, in turn raising the amount of power coupled out.

With both audio/power and rf modules ready to use, the next step is the control circuitry. Its schematic appears in Fig. 3, and has a slightly disorganized look. The circuits in-



Interior of chassis, showing control circuitry and power supplies. Also shows swiss-cheese condition of chassis which was salvaged from junkbox. Front-panel controls, left-to-right, are CW-fone switch, drive control, spot-operate switch, plate tuning, clipping depth, and power on-off.

clude a 40 volt dc supply to allow use of 28 volt dc relays for all controls, the relays themselves, a 150 volt supply for the associated receiver, and all front and rear panel controls. These controls include a mode switch, a drive control, a spot-operate switch, the clipping depth control mentioned earlier, and the main power switch. On the back panel are receiver power socket J4, the key jack, the antenna relay, a 115 volt outlet which is live only when transmitting, the mike jack, the push-to-talk control jack, an 11 contact socket (J5) for unused relay contact access, another 115 volt outlet controlled by the power switch, and a 3 amp fuse.

None of this circuitry is critical; you can tell what each part does by studying the schematic. We simply crammed it in where space was available, wired the whole thing together following commercial practices, then cabled the wiring. The big terminal block appearing in the photo isn't shown on the schematic as it is merely a tie point for various connections.

Future plans for this little rig include two additions: the rf deck, as you can see, has plenty of space left over. This hurts our Scotch spirits, so we're going to put a 50 mc rig on the bottom and add a 432 mc tripler on top. The 50 mc rig will gang-tune with existing 2 meter section. The result will be a true table-top tri-bander, VHF variety.

But in the meantime, just as is, this rig is staying busy at K5JKX. Only complaint from W5PPE is that it gets the same signal reports as his 100 watt 5894 rig! And that's the burden the designer of a top-efficiency VHF rig has to bear!

. . . K5JKX
. . . W5PPE

Transistorized RTTY Converter

Robert Corbett W1JJL
46 Prospect Street
Torrington, Connecticut

In an effort to develop a simple, inexpensive RTTY converter, I went through several different models, none of which worked too satisfactorily, until I came upon the circuit of Fig. 1. This is about as simple as you can get and still obtain good readable copy on the ham bands.

Audio from your receiver is fed through T1 and is limited to a set value by the 13K resistor and the two 1N34's connected across the secondary. The first 2N269 is self-limiting by virtue of the unbypassed resistor in the emitter circuit. Also, you will note there is a fairly large value bypass condenser connected between the collector and ground of this same transistor. The purpose of this is to reduce high frequency noise and signal leak-through.

The second 2N269 is utilized as an amplifier and provides more than enough gain to drive the 1N34 rectifier. Notice that the collector of this transistor is connected to the center tap of the toroid rather than the outside. This is to reduce the loading effect of the collector impedance on the selectivity of the tuned circuit.

Transistor TR3 acts as a dc amplifier and

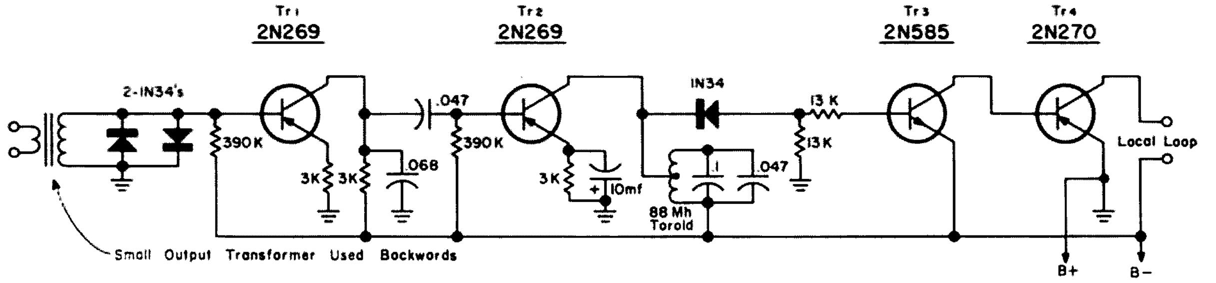


FIGURE I

13K Resistor across secondary of transformer not shown in schematic.

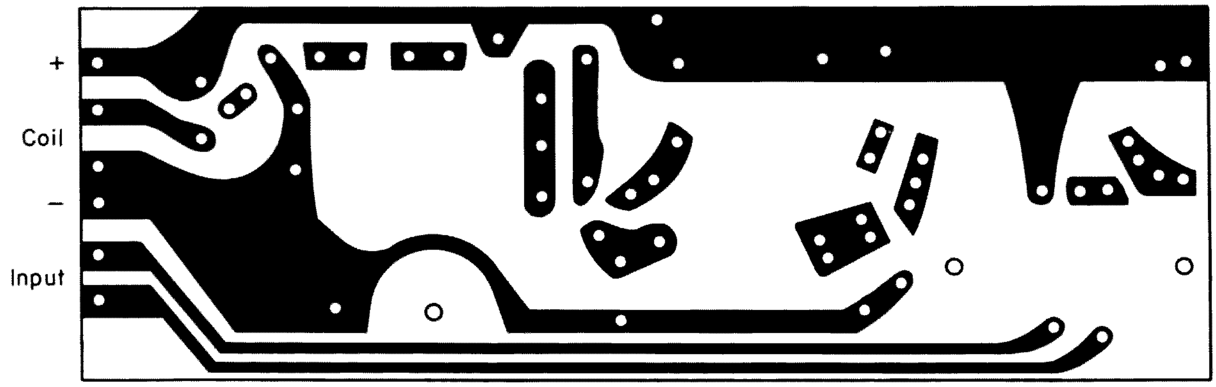


FIGURE 2

builds up the output of the rectifier to a value high enough to key the output transistor. The two 13K resistors in the base circuit of this transistor are the only really critical parts of the unit. I would advice against changing the value of these as they set the current of the output loop. Also it is easily possible to destroy transistor TR3. If you must experiment with these values connect a milliammeter in the emitter circuit of TR3 and watch the value of this current closely. Also be sure that the 1N34 rectifier is connected to the junction of the two resistors not to the upper end, as this also controls the amount of current drawn by this transistor.

With a 12 to 15 volt supply connected the local loop current will be between 60 and 65 milliamperes and can be used to key the machine magnet directly. The tuned circuit is set to the space frequency and when a signal is received, the current in the local loop drops to almost zero.

My version of this unit is built on a home made printed circuit board and the layout is shown in Fig. 2. The full size dimensions are 3 x 9 inches. For connection to the external circuits I use 4-40 bolts and nuts with the heads of the bolts soldered to the printed circuit.

Any inquires will be answered, but please, SASE. Total cost should be about $15 if everything is purchased new.

. . . W1JJL

Modulation Measurement the Simple Way

Jim Kyle K5JKX
1236 N. E. 44th St.
Oklahoma City, Okla.

Through the years, many methods of measuring AM modulation percentage have been described. Some have been simple but only approximate in result; some have been precise but more than just a little complex.

The method described here has not been reported in the amateur press during the last 5 years at least; it is both simple and reasonably exact, and requires the use of only two items of test equipment. While neither is especially common in the usual ham shack, neither are they especially uncommon.

The test equipment required consists of a dc scope of any variety, and an rf probe for the scope.

To make the measurement, simply connect the probe to the scope and connect the probe in parallel with the antenna terminals of the transmitter. The output of the probe will consist of an ac component which represents the modulation, and a dc component which corresponds to the average voltage or carrier component.

With no modulation, the trace on the scope screen will consist of a line at some definite voltage level as shown in part A of Fig. 1. This

line becomes the zero reference for the rest of the measurement.

Now, with modulating signal supplied, the scope trace will shift upward to look like either part B or part C of the figure.

The percentage of modulation is determined by comparing the positions of peaks in the audio waveform with the former zero reference line as well as with the midpoint of the new trace. If the peaks reach down to the original zero reference, you have 100 percent modulation. If they reach halfway down (as in part B of the figure) you have 50 percent. Other distances are in direct proportion. For instance, if the dc level rises by 10 squares with modulation, but the ac peaks extend only two squares either side of this, the modulation percentage would be only 20 percent.

This test measures modulation in only one direction; to measure modulation on peaks of opposite polarity, you would have to reverse the polarity of the crystal in the scope's rf probe. A typical probe schematic is shown in Fig. 2; for full modulation checking it would probably be worth-while to build two of these, identical except for reversed crystal polarity. You would then be able to check modulation percentage in both the positive and negative audio peaks.

. . . K5JKX

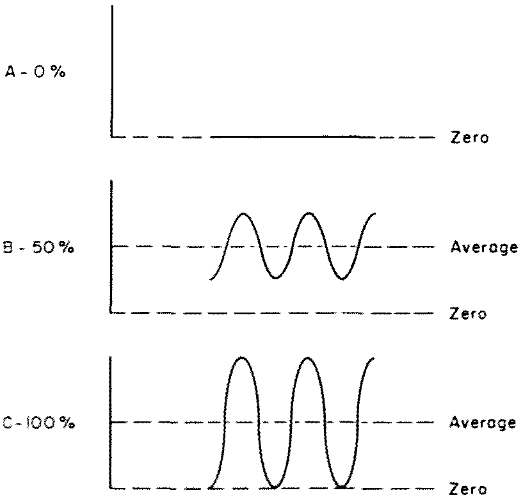


FIGURE 1

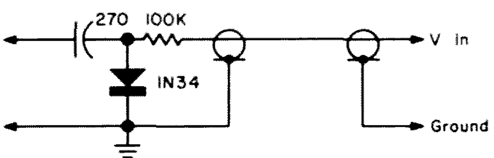


FIGURE 2

John Specialny Jr. W3HIX
728 East Broad St.
Quakertown, Pa.

A high performance, transistorized,

Converter for 144 mc

This report describes a transistor type converter capable of excellent noise and cross modulation performance at 144 mc. It employs four MADT transistors and is crystal controlled. An *if* output frequency of 28 to 32 mc permits the use of a good high frequency receiver capable of tuning this range as the tunable *if* system.

Circuit Description

The common emitter configuration is employed in the rf amplifier, mixer, and crystal oscillator circuits, and the common-base configuration for the frequency tripler stage.

A 2N2398 is used as a neutraized rf amplifier. Coils L_1 and L_2 in conjunction with capacitors C_1, C_2 and C_3 form the antenna input circuit. Shunt capacitor C_1 tunes the circuit to resonance. C_2 and C_3 form a capacitive transformer to match the 50 ohm antenna to the base input. Capacitor C_5 together with neutralizing capacitor C_4 form the neutralizing circuit. Collector tuning is accomplished by capacitor C_6 and coil L_3. Variable resistor R_1 provides manual gain control by a method known as forward gain control. Switch SW_1 permits emitter resistor R_2 to be either bypassed in the noise figure position or not by-

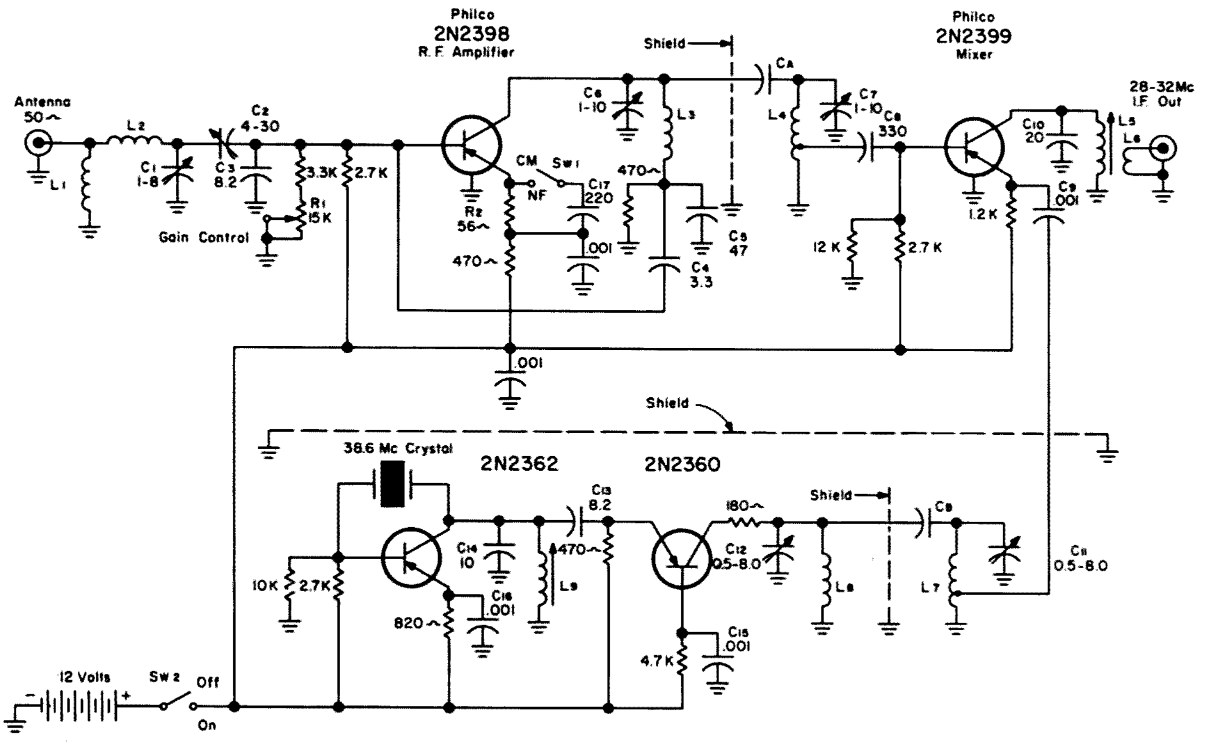
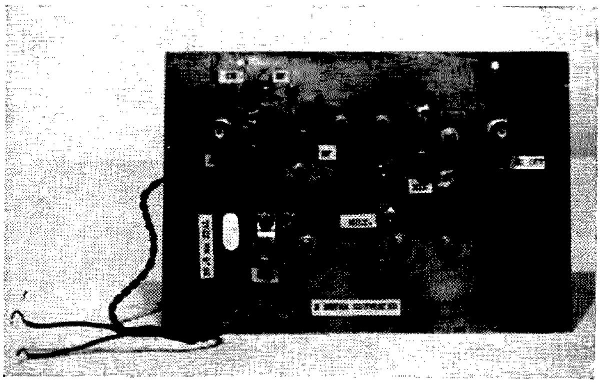


FIGURE 1



passed in the cm position. In the noise figure position, the amplifier operates with the emitter fully by-passed, thus providing best noise figure performance.

In the cm position switch sw_1 removes the by-passed capacitor C_7 resulting in some emitter degeneration, thus improving the cross modulation performance of the rf stage. This improvement in cross modulation unfortunately is accompanied by a 1.5 db degradation of the overall noise figure.

Switch sw_1 should be a quality type with very low "between-contact" capacity (less than 15 pf).

The output of the rf amplifier is loosely coupled to the mixer tuned circuit through capacitor C_A. This capacitor is formed by the small amount of capacity existing between an insulated piece of wire which has been soldered to the collector tank of the amplifier and the high potential end of coil L_4. The insulated portion of the wire is placed on the high potential end of L_4 to form a capacitor having a value of about 0.1 to 0.2 pf and is held intact by dropping some plastic cement on the junction.

The mixer input circuit consists of capacitor C_7 and coil L_4. A 2N2399 is used as the mixer transistor. The 30 mc output is coupled out of the collector to the 50 ohm load-through a tank circuit consisting of shunt capacitor C_{10} and variable inductor L_5 and a link coil L_6.

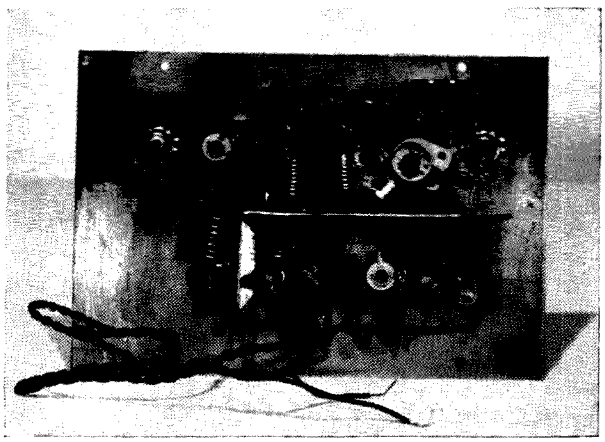


Chart 1

RF Amp.	Mixer	Oscillator	Tripler	Bleeder Current	Total Current
1.8 ma	1.4 ma	4.0 ma	2.0 ma	2.3 ma	11.5 ma

Chart 2

Frequency (desired)	Frequency (undesired)	Signal level for 1% with R_2 bypassed	Cross Modulation Index with R_2 un-bypassed
144.5 mc	150.5 mc	* 3.7Kμv	* 7.1Kμv

The local oscillator power is injected at the emitter terminal of the mixer through by-pass capacitor C_9 and a tap on coil L_7. Capacitor C_{11} tunes this circuit to 116 mc.

This tank circuit is loosely coupled to the tripler tank through capacitor C_B which is made up in the same fashion as capacitor C_A. The class "C" tripler uses a 2N2360 transistor and obtains its excitation from the crystal oscillator stage through a series matching capacitor C_B. Shunt capacitor C_{10} and coil L_9 tune the oscillator collector circuit to 38.66 mc. A 2N2362 is used in the oscillator stage.

Chart 1 indicates the approximate current drawn by the various stages of the converter.

Results

The overall power gain of this converter was measured to be 32 db with a noise figure of 3.9 db when switch sw_1 is placed in noise figure position. By placing switch sw_2 in the cm position, the observed noise figure was 5.4 db. However, the cross modulation characteristics were improved. (See Chart 2 for data)

COIL DATA

L_1 = 2 turns #18 tinned copper wire 3/16" I.d.
L_2 = 3 turns #18 tinned copper wire 3/16" I.d.
L_3 = 9 turns #18 tinned copper wire 3/16" I.d. winding length 5/8"
L_4 = 9 turns #18 tinned copper wire 3/16" I.d. winding length 5/8" base tap 1 turn from low potential end.
L_5 = 22 turns #28 nylclad copper wire on 1/4" ceramic form. C.W. with powdered iron core (VHF grade).
L_6 = 3 turns #28 nylclad copper wire over low potential end of L_5.
L_7 = 7 turns #18 tinned copper wire 5/16" I.d. W.L. = 1/2".
L_8 = 7 turns #18 tinned copper wire 5/16" I.d. W.L. = 3/4".
L_9 = 18 turns #28 nylclad closewound 1/4" dia. form. with powdered iron core (VHF grade).
* Across the 50 ohm Converter Input.

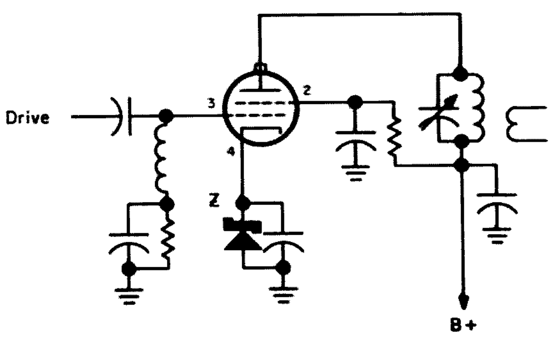
A New Method of Biasing Tubes

Robert Schuetz W2BDG

Over the years a number of low power transmitters have been built at W2BDG using 807's or similar tubes as the output amplifier. A frequent problem has been the stability of the final when the grid drive is removed and the plate tuning capacitor is rotated throughout its range After parasitics have been eliminated, the problem is usually one of grid biasing.

There are various methods of biasing tetrode final amplifiers such as grid resistor, cathode bias, or fixed bias. In order to protect the tube in the absense of grid drive, some form of protective bias or a clamp tube arrangement is often used. At one time a 45 volt battery supplied bias, but now a clamp tube is frequently used.

807W



One of the recent developments in semiconductor electronics has been the zener diode, which has the very useful property of maintaining a constant voltage across the diode when varying currents are flowing through it. A zener diode of the proper voltage and wattage rating can be connected between the cathode and ground of tubes operating with varying cathode currents to give a constant value of grid bias. The following circuit shows how bias is obtained for the driver amplifier of the transmitter at W2BDG.

The zener diode–Z–is used to supply protective bias to the amplifier by maintaining the cathode 43 volts above ground. The remainder

of the operating bias is supplied by a grid resistor. With plate and screen voltages and no grid drive applied to the stage, the cathode current is less than 10 milliamps and the stage is completely stable. The particular zener diode is a 1N2993 (1OM43Z5) which is rated for 43 volts and 10 watts. The cathode of the diode is connected to the mounting stud, and all that needs to be done is to drill a hole, mount the diode to the chassis, and connect the anode of the diode to the cathode of the tube. The usual cathode by-pass capacitor (about 0.005 mf) must be connected across the diode. The wattage rating of the diode is determined by multiplying the voltage drop across the zener diode by the maximum current through it. The diode having the next higher wattage rating and the proper voltage rating is selected. When high wattage diodes are being used, care should be taken to insure that a proper heat sink is supplied.

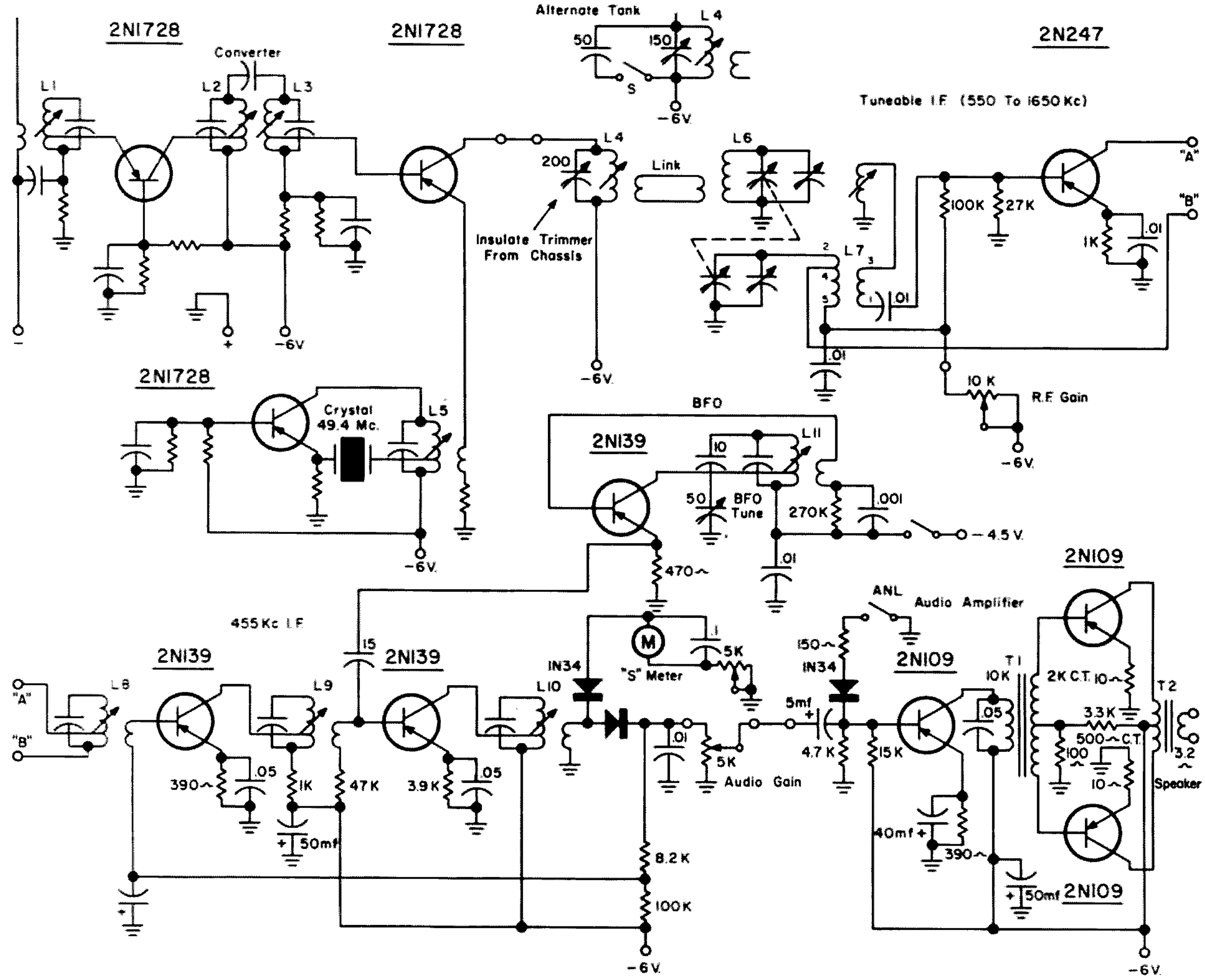
Zener diodes can be used for biasing class B amplifiers and in other applications. The price of zener diodes is a deterrent to many amateurs, but the price is being reduced and the simplicity of their application makes them very useful.

. . . W2BDG

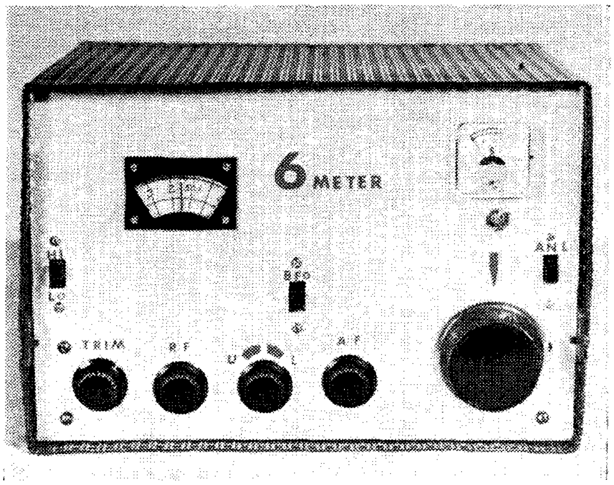
Transistorized 6 Meter Receiver

Capt. John Sury W5JSN

Do you need a 6 meter receiver that is small and compact and has sensitivity as well as selectivity? Here is a challenging project. The receiver has 10 transistors, a crystal controlled front end, double conversion, and a bfo for CW and SB reception. All of this is installed on printed circuit boards. You know the old caution to take: keep leads as short as possible. On this project, forget it. The printed circuit takes care of those things for you. The receiver does a fine job on AM, CW, and SB. Total power supply is 4 large flashlight batteries, which do not need replacing very often. Idle current is approximately 15 ma and peaks to approximately 30 ma with an automatic noise limiter to boot. The ANL sure comes in handy around congested areas where ignition noise is a problem. It measures 9 inches wide, 6 inches high, and 8 inches deep. The miniaturization ham can build this receiver a lot smaller, because there is plenty of room to spare in the one built by the author.



Note: Converter board insulated from chassis with phenolic board on converter is negative and chassis is positive.

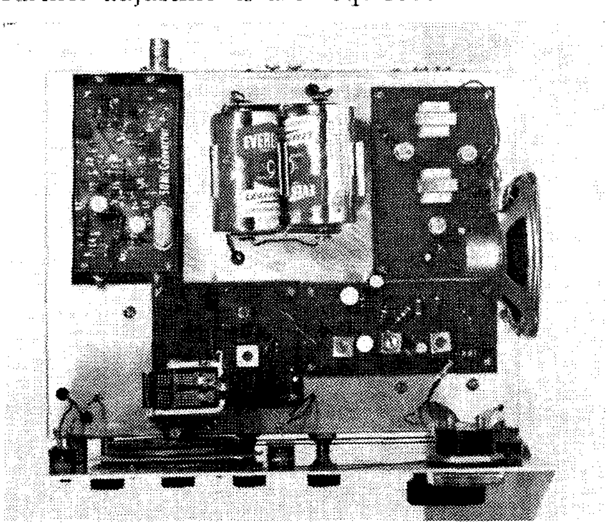


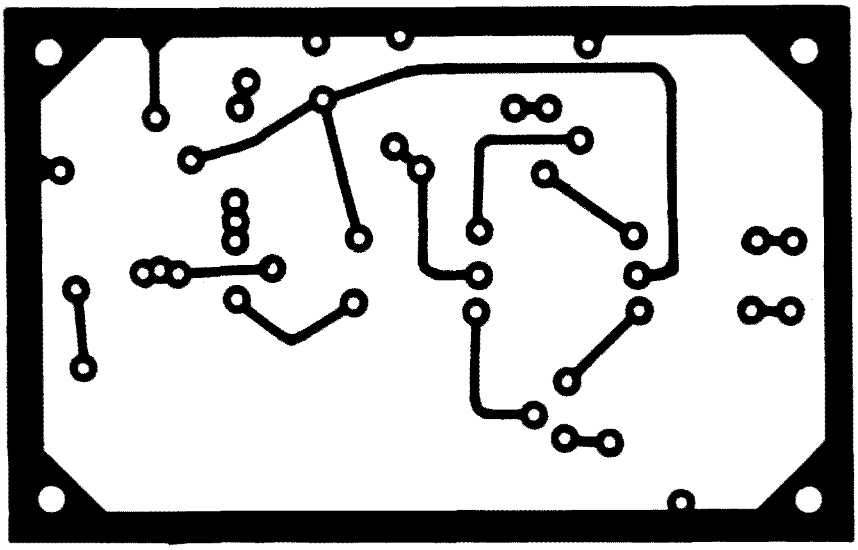
All printed circuit boards were constructed except for the front end crystal controlled converter, which was purchased at Irving Electronics in San Antonio for a little over $3. This included the board and all the coil forms—a very fine buy. The author was a little impatient, so he did not bother to build the front end from scratch. The tunable if is the Broadcast band from 550 to 1650. This will cover 1 mc with good sensitivity and selctivity.

Only 1 transistor is employed by the tunable if; one thing it saves is 1 transistor for some other location as well as saving time trying to lick a stability problem in the oscillator. The tunable converter used in this receiver is rock stable.

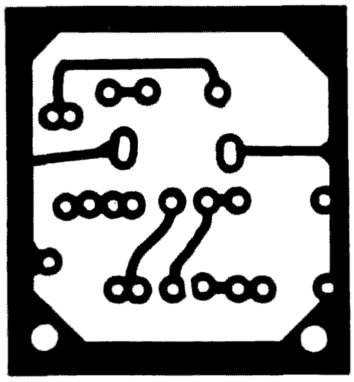
A 2-stage 455 kc fixed if was used. The ordinary run of printed circuit if cans for transistors, obtained from several of the electronic warehouses, were used. They are small and compact and allow easy mounting on the printed circuit board.

The bfo employs 1 transistor. The circuit appears to be very stable. The author is sure a crystal controlled bfo would have more stability; although once an SB station is tuned, no further adjustments are required.

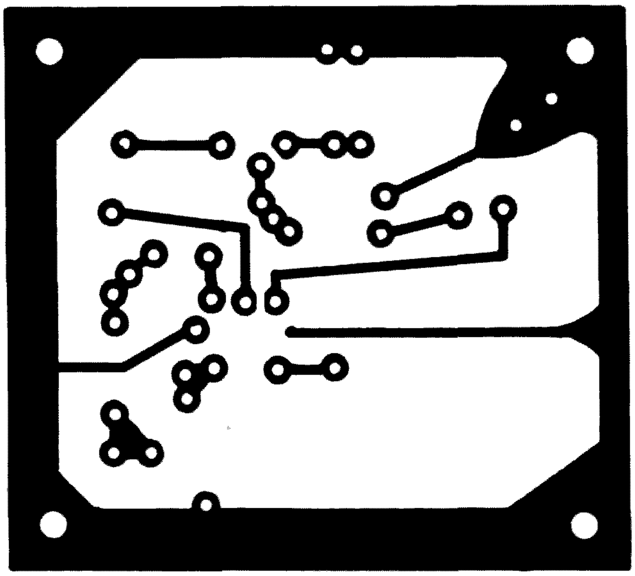




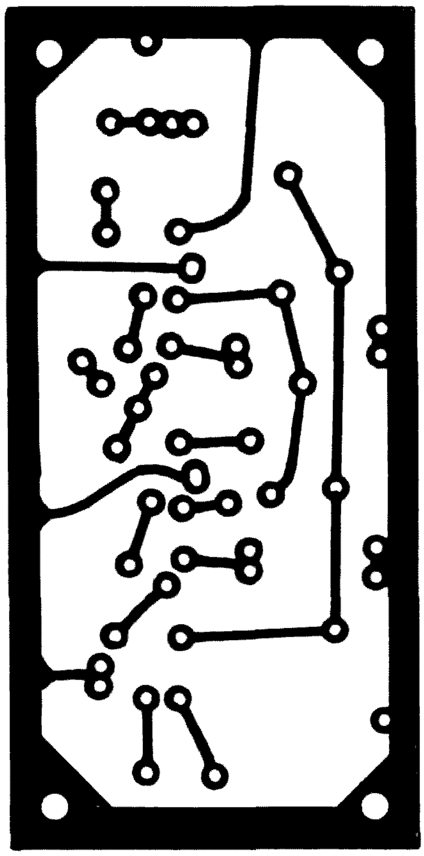
Audio Amplifier



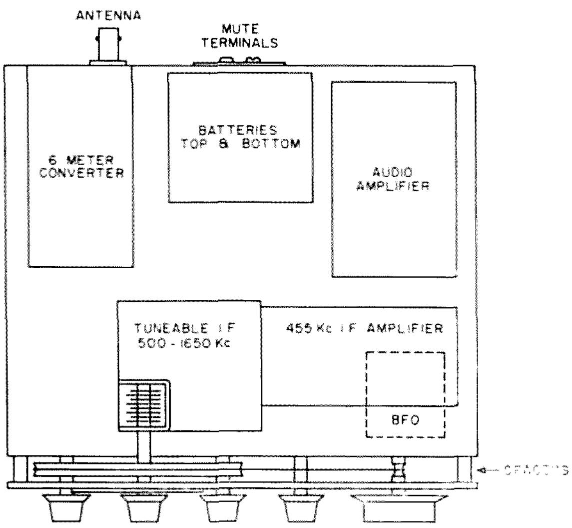
BFO



Tuneable if Amplifier



455 kc if Amplifier



Boards shown actual size

Brief Instructions

Cut out the above boards. Lay the patterns over the board desired to be made. With a scribe mark holes. Drill holes with a #56 drill. Paint resistant with a small brush as pattern indicates. Put each solution in a plastic container and place board face down. It requires about 45 min. to complete. It may require a little longer. Remove the board and remove restant with thinner or gasoline. Wash board with soap and water. Enlarge the holes which are required to fit some of the components. Solder the components in place.

The audio amplifier is a standard class B push-pull 3 transistor amplifier. There is a slight forward bias applied to the 2 output stages, so the transistors operate in the linear region of their own characteristics and reduce cross over distortion. Any 3.2 ohm speaker will do a good job for the listening end.

The printed circuit board construction technique will not be covered here, since there have been many articles published on this art. Each section was constructed separately and mounted on an aluminum chassis 9 x 7 x 2 inches. Refer to the photographs.

By scrounging a 3-inch pulley from a local TV technician, the vernier dial was constructed. Just about anything will do the job; but for fairly easy SB tuning, the ratio for the tuning capacitor should be at least 8:1. Cut out a circular piece of heavy paper. Cement loosely to the pulley, and calibrate the dial. Remove the paper, and mark the calibrations permanently with India ink. After it dries, spray it with a plastic spray; and after this has dried, re-cement to the pulley.

Audio Amplifier

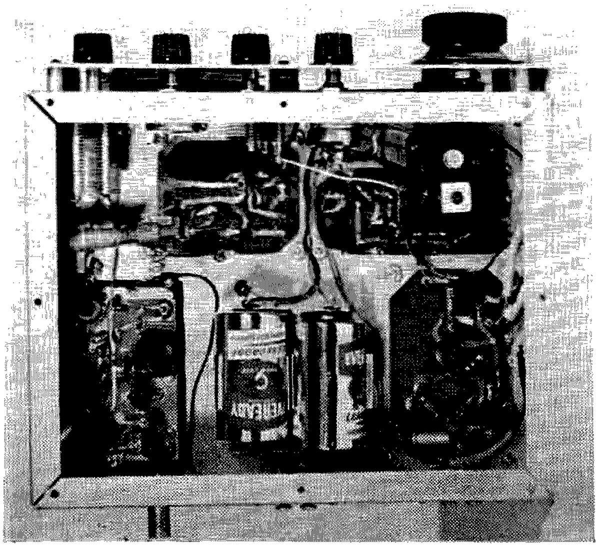
Parts in the amplifier are quite common. The driver transformer is 10k primary and 2k secondary CT. The output transformer is 500 ohms CT and 3.2 secondary. Instead of cutting holes in the printed circuit board for the sockets, small holes were drilled so that the socket lugs might be soldered into the board. The transistors may be soldered in permanently but this does not allow for changing around the transistors to get the best output. Even the same type of transistors will not all have the same alpha or beta values. The printed circuit layout is full scale. Refer to schematic in placing resistors and other components.

If Amplifier

The if coils are minature Calrad, type PV-03 and PV-104. If other types are used, the printed board will have to be changed. Here again, the transistors were not soldered in permanently.

Tunable IF

Only 1 transistor is used here. A transistor with an alpha frequency cutoff of at least 9 mc should be used. For good operation, the transistor should not be operated at a frequency any higher than 25% of the alpha cutoff frequency. The 1 transistor serves as the oscillator and mixer. A Miller #2021 oscillator coil and a #2110 variable condenser mounts in place. For the mixer coil, the Miller #2007



loopstick coil tunes 550-1650 kc's.; this is the if tunable range. Any coil with the same inductance can be substituted.

50 mc Converter

This is a 3 transistor converter, #34, by Dan Meyer, which is sold by Irving Electronics of San Antonio. The kit includes all of the coil forms and the printed circuit board. One word of caution if this converter is used: the outer part of the board has to be insulated from the chassis because of the polarity. By using this converter, the author saved a lot of time. A third overtone crystal of 49.4 mc will give 50-51 mc coverage. The output coil is wrapped with 120 turns of Litz wire. A 200 mmfd variable capacitor is placed in shunt with the output coil to be used for peaking the signal. The author only had a 150 mmfd Trimmer, so a switching arrangement was made to parallel a fixed 50 mmfd capacitor. With the 50 in, it coverd the low end of the band; and with it out, it coverd the upper end of the band. Approximately 8 turns is all that is required on the oscillator coil. Link coupling between the mixer coil, and the converter output coil seems to work the best. Three turns over each coil is sufficient. Any more turns than 3 for the link broadens the tuning as well as overloads the tunable if.

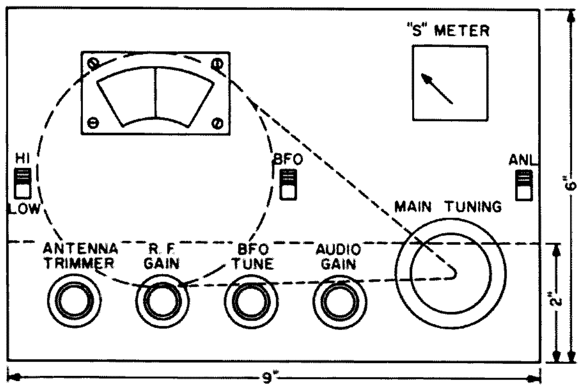
Bfo

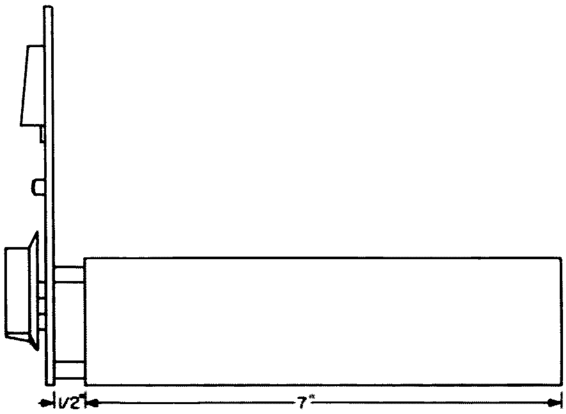
Let the board and schematic be your guide. The coil is a Lafayette MS 268 if coil. For bfo, batteries, and speaker locations, refer to photographs.

Alignment

The alignment of the 455 kc fixed if and the tunable if (oscillator mixer) will not be covered. Any handbook covers this procedure quite thoroughly. This part is only a standard BC receiver (550-1600 kc). When the receiver is ready to fire up with the 50 mc converter installed, it is ready to align for 6 meter operation. This is a simple procedure. The signal generator lead can lay loose on your work bench. Set it on approximately 50.5 mc. Tune the receiver for this signal; start with the front coil, and start peaking. Make sure the crystal is oscillating. If a meter is put in series with the batteries, the curent will change when a finger is placed on the oscillator coil. A vacuum tube voltmeter with an rf probe can be a good indicator for peaking the oscillator coil. Adjust the slug in the output coil with the peaking variable capacitor approximately half meshed for maximum signal. This will allow peaking at the lower, as well as the upper, section of the band. If better coverage is desired with less sensitivity, the converter can be stagger tuned. With the bfo on zero beat an unmodulated carrier from the generator, adjust the slug in the bfo coil with the 50 mmfd capacitor half meshed. By rotating the bfo knob on the front of the receiver to the left, it tunes USB; and rotating it to the right will tune LSB. The rf control is a 10k pot in series with the battery and the tunable if. This reduces the overall voltage on the tunable if, reducing the sensitivity and only changing the frequency slightly.

You will be amazed at the sensitivity, as



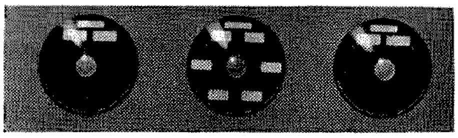


well as the selectivity, of this receiver. The S-meter is optional; (refer to schematic). The author has used the receiver for the past 3 months for local and also DX contacts. Muting is accomplished by disconnecting the battery by means of the contact points breaking on transmit on the antenna relay. Printed circuit board construction is here to stay; just try it, and you will agree.

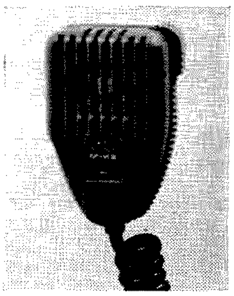
. . . W5JSN

New Products

Illuminated Knob



Waters has been at it again. . . hardly a month goes by without something new from Bob. This time it is an illuminated Knob. Yep, a little light beam comes out and indicates the setting of the control. A red arrow also lights up on the knob. Pretty, flashy, eh? The mount on the regular ¼″ shaft, which serves as a ground, and a wire goes from the knob to a 6 volt filament connection. $5. Check this at your local distributor. Should be great for mobile as well as the shack.



New Mike

Those of you who have used noise-cancelling microphones appreciate the advantages of this type of design. While it doesn't make a lot of difference around the normal ham shack, the background noise can be very objectionable in a mobile installation. Altec Lansing has just come out with a new hand-held noise-cancelling dynamic microphone which looks like a fine bet for the mobile ham station, the Dyna-Mike. It comes in models with or without a built in transistor amplifier. Watch for the Dyna-Mike at parts distributors or drop a note to Altec, 1515 S. Manchester Avenue, Anaheim, Cal.

Robert Tellefsen W7SMC
14533 32nd NE
Seattle 55, Wash.

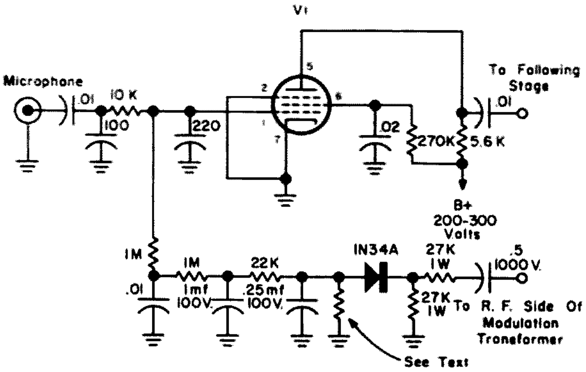
Speech Compression for Mobile Transmitters

Is your mobile modulator loafing, cheating you of talk-power that you can't afford to lose? Chances are that it is. In any AM transmitter 100% modulation is the accepted ideal; in a mobile transmitter it is an absolute necessity because of the more adverse operating conditions. Yet mobile transmitters, although fully modulated, are frequently short on audio. How can this be?

An AM transmitter adjusted for 100% modulation with sine-wave input will sound undermodulated with speech input. With sine-wave input, every peak results in 100% modulation, but with speech input, only the highest peaks hit 100%. Because the amplitude of human speech components varies wildly, the average modulation level of an AM transmitter is around 35 to 45%.

There are two ways to raise the average level of modulation without exceeding 100% on peaks—clipping and compression.

Speech clipping is quite effective, as is shown by its use in many fixed stations. However, inclusion of speech clipping in a modulator requires additional tubes, space and adjustments. Also, clipping a voice signal distorts it and produces harmonics which must be removed by a bulky L-C low-pass filter. For these reasons, speech clipping is seldom found in small, low-powered mobile transmitters.



Cheaper, easier to adjust and equally effective, speech compression is a natural for mobile work. Only one tube is required, and because no clipping occurs, no low-pass filter is needed. There is little distortion of the speech signal with compression, making it unnecessary to sacrifice fidelity for increased communications effectiveness, as is the case with speech clipping.

The most important advantage of compression is simplicity. The circuit takes up little space, and, if the first stage of audio amplification in your modulator is converted to a compression circuit, the compression tube is "free on board."

The circuit in Fig. 1 is modified version of the "Speak-Easy," and is similar to the avc circuit in a receiver. Designed around a variable-mu tube, the 6BA6, it has a wide range of gain and can be driven directly by a microphone.

In operation, low-level audio from the microphone is amplified by the compression tube and the following stages. High-level audio, taken from the secondary of the modulation transformer through blacking capacitor C^1 and voltage-divider resistors R^1 and R^2, is rectified by diode D^1 to give a negative bias voltage at the control grid of the 6BA6. An R-C filter network with a short time-constant smooths this bias voltage without distorting its syllabic variations. A high-energy syllable will produce a large negative bias voltage and reduce the gain of the tube for the remainder of that syllable's duration. A weak syllable will produce a small bias voltage, effectively increasing the gain of the 6BA6. This gives a modulator output in which high-energy audio peaks are compressed and low-energy peaks are amplified. This results in a higher average level of modulation, yet the audio peaks never modulate the transmitter more than 100%.

Since this compression circuit is offered as a modification for existing equipment, and as idea material for future equipment designs, no construction information is given. However, some suggestions may be helpful.

If the first stage of speech amplification in your modulator a 6AU6 or other 7-pin miniature pentode, this circuit can be incorporated by rewiring the socket and plugging in 6BA6. This circuit has sufficient gain for use with crystal, ceramic or dynamic microphones.

Since this circuit consits mostly of resistors and capacitors, they could be mounted on a small phenolic board and placed wherever there is room under the modulator chassis. Wires could then be run to B+, ground, modulation transformer secondary, and 6BA6 grid and plate. Shielded wire should be used for the grid and plate leads to prevent hum pick-up and the possibility of feedback.

Of course the circuit could also be built as an outboard unit and used between the microphone and the transmitter. This would require bringing out high-level audio from the modulation transformer secondary to the outboard unit.

Although the emphasis is on simplicity, this circuit must be adjusted before it is used. With your transmitter operating into a dummy load, voice modulate it and observe the modulation percentage on an oscilloscope. Adjust resistor R^3 so that –4.5 volts appear across it when the transmitter is 100% modulated. An easy way to do this is to temporarily substitute a 10,000 ohm pot, rheostat-connected, for resistor R^3. Adjust the pot for –4.5 volts while holding a long syllable, such as aaaah or eeeee, and then remove the pot and measure its resistance. Replace it with a 10%, ½ watt resistor of the nearest commercial value. This completes the adjustment of the compression circuit.

As a check, speak loudly into the mircophone; the modulation level should not exceed 100%. Now speak softly; the gain of the compression tube should keep the modulation level up, although not necessarily to 100%.

With the addition of speech compression to your mobile modulator, you can be sure that your modulator is earning its keep and that your signal will have the necessary audio punch to get through when conditions get rough.

. . . W7SMC

Mobile Power Supply

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The following data was obtained experimentally:

1. Ferrite material used in TV yokes and flyback transformers is the same stuff they use in commercial toroids.
2. Single flyback core (larger size) or a single yoke core is about right size for 50 watts output operating around 400-600 cycles .
3. Sections can be stacked (see Fig. 1) for higher power.
4. Ferrite cores can be reduced to powder, mixed with Epoxy Cement (4 parts powder to 1 part of resin) and used to glue sections together, fill the cavities or even to mold your own cores.
5. About one turn per volt is right for a 150 watt transformer, two volts/turn for a 300 watt job.

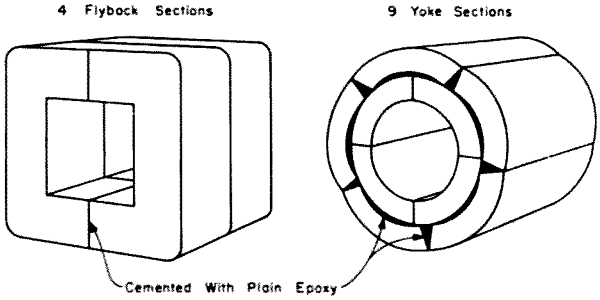

FIGURE 1

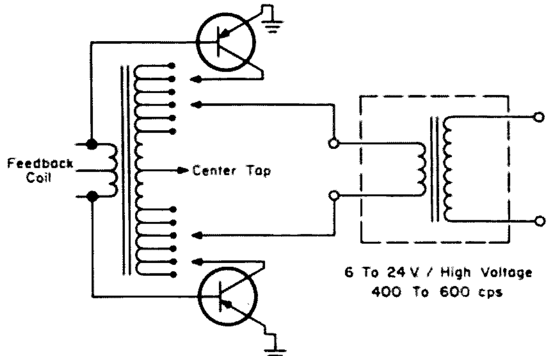

FIGURE 2

6. You do not need a high voltage secondary winding if you use circuit Fig. 2; this will reduce your coil winding to probably less than ten turns.
7. There is nothing wrong with "cheap" 40 watt transistors that sell for 50 cents to a dollar each. I bought about a dozen of them from various sources, and only one was bad.

If you match them–they can be paralleled, each pair producing about 75 to a 100 watts in a 12 volt system.

Power supply built according to a circuit (Fig. 3) is producing 100 watts at 110 volts and about 600 cycles. It is using 9 yoke core sections cemented together as explained in (4) to form a toroid. 1½ turns/volt ratio was used, primary has 18 x 18 turns Nr. 14 enameled wire, fedback winding has 12 x 12 turns Nr. 24, and the 110v secondary is 165 turns Nr. 20. Efficiency is close to 80–85%.

The circuit is a standard grounded emitter. It is using four 40 watt transistors mentioned above. It is suggested that resistors R1 and R2 are made variable and an ammeter inserted in series with the feedback centertap (it reads 1 amp) during preliminary testing. A good heatsink is essential.

The only other part requiring some explanation is Rx. It is one foot of bare copper wire, coiled around mica support, and running very hot–over 100 degrees Centigrade–at full power (wire size will depend on the power you are running). It does three things:

1. Tends to equalize currents through four transistors.
2. Acts as a fuse.

3. Permits easy matching of the transistors, which is done by measuring voltage drop across each Rx resistor. I use test prods of my VOM in 2.5 ma position; all you need is a relative indication.

The 400–600 cycle output can be transformed to a higher voltage using separate transformer, or can be rectified using voltage doubling or quadrupling which is very easy at these frequencies. The cost of 400 cycle transformers is quite low, and they are several times smaller than their 60 cycle counterparts. This of course permits construction of about 200 watt supply for about ten dollars, depending mostly whether you have a friend in a TV repair shop.

. . . K6B1J

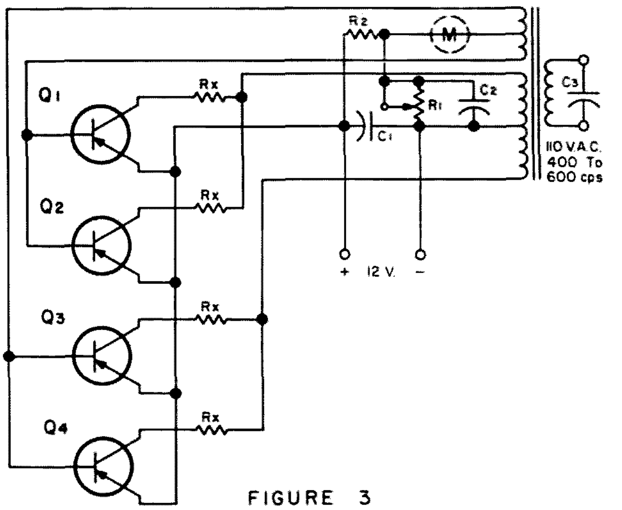

FIGURE 3

Fig. 3 Notes

Q 1, 2, 3, 4.—40 watt transistors see text.
R1—HO ohm 5 watt n series with 10 ohm rheostat.
R2—150 ohms 10 watts.
RX—Equalizing resistors, see text.
C1—1000 mfd 25 volts or more.
C2—50 mfd 25 volts.
C3—.01 1200V Mica.
M—0-5 amps meter (neded during testing only).
Toroid transformer constructed as in Fig. 2 (9 sections TV yoke cemented together).

Neatness Does Count

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The status of "amateur" is no excuse for the sloppy wiring which seems predominant among hams. This is only the result of an unwillingness to spend a little extra time to get a neat layout. By overcoming this inertia, and the application of some lacing twine, this problem would be eliminated.

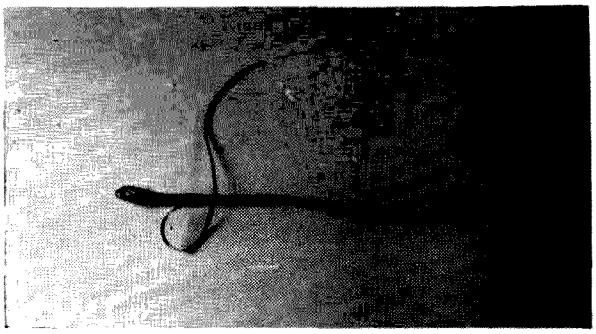
Lacing tools. L to R: Lacing mitt; hooked scribe; lacing twine; wire cutters; lacing mitt.

The basic lacing stitches are very simple. Anyone can lace, and the difference that it makes in your projects is well worth the time and effort.

It would be advisable to have some flat-braided nylon lacing twine, which is available surplus at very reasonable prices; if you buy it from your retail dealer, a 600-foot roll will cost about $9.00. Regular nylon twine will do. You'll need a pair of wire cutters because it is almost impossible to break the twine in your bare hands. A hooked scribe is used to pull the twine through tight spots.

The starting stitch is a clove-hitch knot, illustrated in Fig. 1.

Take a group of wires to practice on and lay them on the bench perpendicular to you. Cut a 12-inch length of lacing twine. Pass one end under the wire until the twine extends approximately seven inches on the left of the wires and five inches on the right. Bring both ends up vertically and pass the strand in your



Laced cable, showing proper spacing and loop for next stitch.

left hand ("the left strand") behind the other strand (the right strand) and change hands. Then pass the left strand under the wires, leaving a loop, in front of the right strand, and then through its own loop. Pull tight and you have a clove-hitch knot. To be sure that you have a secure start for your lacing, make a square knot over the clove-hitch. The square knot is just to hold the clove-hitch in place. Practice this knot a few times to get the feel of it.

The lacing stitch, illustrated in Fig. 2, is equally painless. Make your clove-hitch, as before, but leave about two feet on the end where you previously left the five inch piece. After tying the square knot, cut off the short piece about ⅛-inch from the knot. The clove-hitch could be used throughout, creating a neat layout, however, lacing is much neater.

With the wires as before, grip the long length of twine between the thumb and fore-finger of your left hand, about three inches from the knot, and double the twine back upon itself forming a circular overhand loop. This loop is parallel to the table and is to the left of the wires. Pass the end of the twine over the wires, then around and under them, and through the loop from the bottom. Grip the free end and pull tight. You have just made the lacing stitch. Practice a few more and try to space them evenly about ½-inch apart.

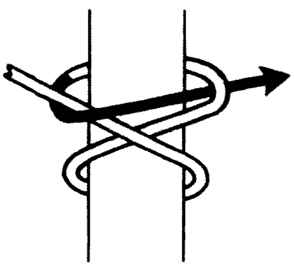


FIGURE 1
The clove hitch knot

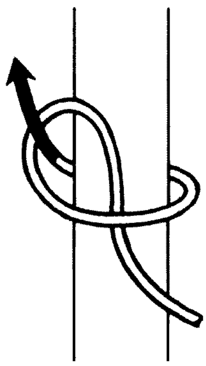


FIGURE 2
The lacing Stitch

To end, make one lacing stitch and then make another right next to it. With a scribe, or similar tool, force a space under the twine between the two stitches and pass the end of the lacing twine through the created space. Pull tight for the ending stitch. Cut off the excess leaving about ¼-inch after the ending stitch.

This lacing is known as a "Westinghouse" stitch. Each stitch pulls against the others and makes for a very tight cable. If you take out the stiches, you will note that they have cut into the wire, giving some indication of how tight the lacing actually is. That is the reason that I specified "flat-braided" nylon twine. When you pull the stitch tight you stretch the twine. Later, when the twine contracts, the knot is tightened against the cable.

All wires are placed together in a straight line and all turns are at right angles. Lacing is started at an extreme end and continues for the greatest possible length. A general rule of thumb is that the lacing twine be three times the length of the cable to be laced. With experience this rule can be modified for less waste.

Wires entering or leaving the cable are called branch-offs. These may be one wire or a group of wires, all at 90-degrees to the cable. A stitch is placed before and after every branch-off. Where a smaller cable branches-off the main cable, it is advisable to lace this separately.

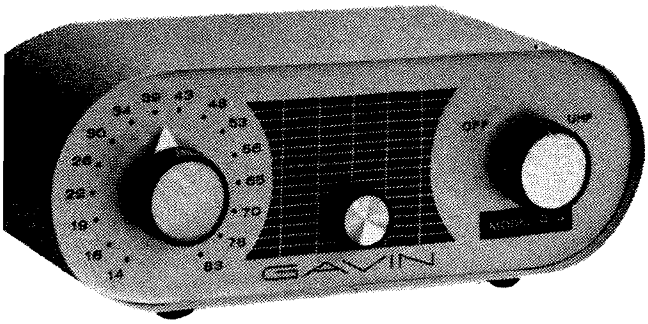
The wires may be laid out before wiring and laced outside the chassis. This method entails some extra work, but makes final wiring much easier. Wires should be color coded for ease in trouble-shooting.

Lacing twine is inexpensive and mastery of the techniques involved will allow you to be proud of your home-brew equipment. *Neatness does count!*

RTTY Docket

The FCC, in Docket 15267, proposes that RTTY stations be obliged to give only their own call on CW for identification instead of both stations in contact as previously required. This certainly would simplify matters, making for less time wasted in the dual identification procedure and permitting the use of automatic CW identification systems which would expedite RTTY communications.

RTTY'ers would do well to drop a note to the FCC announcing their aproval of this docket. If this one falls through you can think of it every time you have to make that full dual identification and kick yourself for laziness.



3/4 Meter TV

The easy way

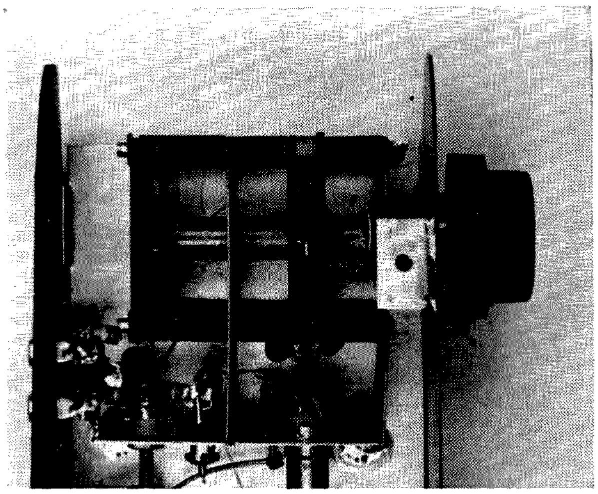
Samuel Daskam K2OPI
R. D. I.
Lebanon, N. J.

Before jumping into a new mode of operation, or even a new band, many amateurs prefer to put a minimum amount of expense and time into determining the characteristics of the band. This is especially true of the VHF bands where the level of station population and band useage varies greatly according to the location.

The 420 to 450 mc band has appealed to a great many people because of the variety of transmission modes available and the availability and ease of construction of high gain antennas. The lifting of the old 50 watt power limitation will also help build the popularity of the band. One of the easiest ways of taking a peek at the ¾ meter band is to use a commercially built UHF TV converter. It should be pointed out, however, that these converters will not offer the ultimate in UHF reception, but are only offered as a starting point.

Recently a new UHF TV converter (for TV Channels 14-83) was announced by Gavin Instruments (of Maverick filter fame) which looked promising on the 420 to 450 mc band. It consists of a tunable nuvistor oscillator using a diode mixer to convert the TV signal down to either Channel 5 or 6. A tunable filter which tracks with the oscillator keeps the local oscillator from going back out the antenna. The Gavin converter uses a 6CW4 as a tunable oscillator and a 1N82A mixer. Frank Hunter of Gavin told me, however, that the current production uses a microwave diode similar to the 1N21 which has a lower noise figure than the 1N82A.

An added bonus received in the Gavin converter is the rating of the power supply. Although the nuvistor oscillator draws only 6 ma. at 70 volts, the power supply is rated at 30 ma. This will allow the addition of a nuvistor rf amplifier ahead of the mixer which should give excellent results. Since isolation would be



furnished by the rf amplifier stage, the filter could then be removed from the active circuitry without fear of the local oscillator signal going out the antenna lead and being radiated.

The only conversion necessary is to locate the filter section which is tuned by rotating the inner control shaft. The filter is situated at the rear of the two ganged tuned lines. Note that the filter will only rotate about 15 degrees with any specific setting of the channel selector, as it is restricted by a protrusion on the larger outside shaft.

Careful use of a hacksaw blade will remove the protrusion and allow the inner shaft to rotate a full 360 degrees. This will allow the filter to tune independently of the oscillator.

The converter, when used as a ¾ meter converter, will have the oscillator working above the signal to be received. The ¾ meter band will be found around channels 34 thru 38 when turned in on Channel 6 of a conventional VHF TV set. For voice reception, an existing communications receiver may also be used. For a 6 meter receiver (50 to 54 mc input) the ¾ meter band will be found on the Gavin converter around channels 26 thru 33. For a two meter receiver this band will be found on channels 28 thru 35.

It should be noted that this conversion does not preclude the use of the converter for regular UHF TV reception. The only problem will be that the filter will have to be adjusted over a greater range then would have been necessary before removal of the filter shaft stops.

Swan Transceiver Modifications

AGC amplifier and AF/RF gain control

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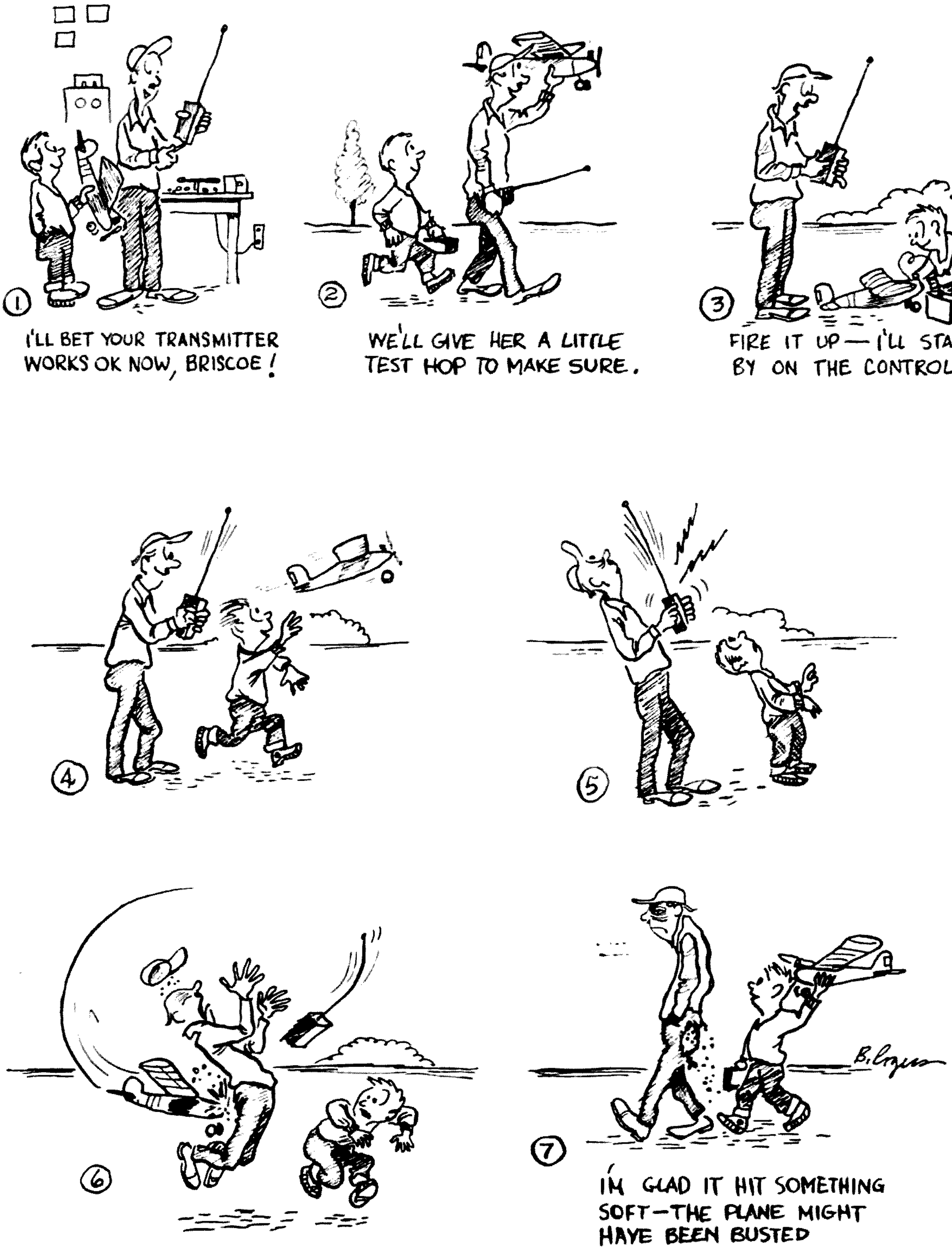
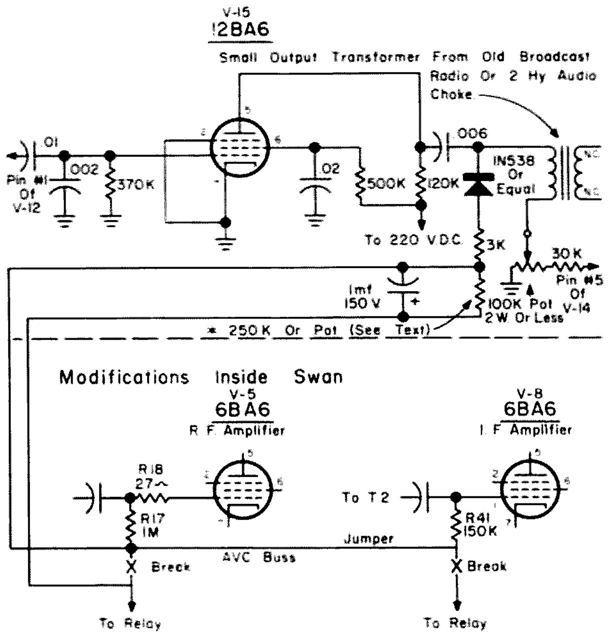
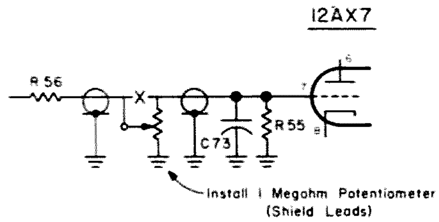
After trying several AGC circuits in the Swan SW-175 transceiver and finding them all lacking in one way or another, I decided to try my own hand at designing one. The prime reason being that in the Dallas—Ft. Worth area we have about 50 mobiles all using the same freq of 3915 kc and some of them will be right on your bumper, and others as much as fifty or so miles away. Needless to say, some knob twisting had to be done if I was going to keep the XYL and the speaker both in the gas buggy. The requirements for such an AGC are simplicity of design, cost, and last but not least, an ability to control the amount of audio coming out of the old squaker with only a few micro-volts of rf signal up to the "Wise Guy," who sneaks up on your bumper and hollars "Hello dawh, you copy—??"

The following schematic is offered as a cure to this rear bumper joker. It is a revised circuit, which was first published in 73, April 1962 by K6SHC which worked reasonably well except that its range of control was limited due to not having a separate rf gain control beyond the take off point of the rectifier which furnishes negative voltage back to the rf and if amplifiers. When an extra strong signal was received that necessitated turning down the volume control, the AGC circuit was then fed less voltage which resulted in less AGC action on the front end, and you were consequently right back where you started.

This difficulty can be overcome by the installation of an audio gain in the K6SHC circuit and taking off the AGC voltage ahead of the audio gain control. The low level voltage


I'LL BET YOUR TRANSMITTER WORKS OK NOW, BRISCOE!
WE'LL GIVE HER A LITTLE TEST HOP TO MAKE SURE.
FIRE IT UP—I'LL STAND BY ON THE CONTROLS!
I'M GLAD IT HIT SOMETHING SOFT—THE PLANE MIGHT HAVE BEEN BUSTED





present at the plate of either the product detector of the 1st audio stage, necessitates construction of an AGC amplifier to get the necessary voltage for proper AGC bias.

The construction of the circuit is not critical, and choice of tubes which will work satisfactorily is wide; a 12BA6 was used solely because one was handy. The tube was mounted on an "L" bracket horizontally underneath the chassis in the vacant area just behind the lower half of the disc dial next to the front panel, with the pins of the tube toward the present volume control. This position places the connections to the base of the tube next to a terminal strip where 220 volts is available (hot side of R-57 100k plate resistor of V-12). The mounting of parts underneath is quite easy due to the unused space in the Swan. The AGC level adjustment pot may be mounted on the back panel along side the power plug. A one meg. pot may be substituted for the (*) 250k fixed (Decay time) resistor, which is across the 1 mmfd capacitor. This would serve as an adjustable fast or slow AGC control. This would be mounted on the back panel with the bias and gating control. However, if a 1 meg pot is used instead of the fixed 250k resistor for an adjustable AGC decay, then a 40k ½ watt resistor should be placed in series with the pot to provide a minimum resistance across the capacitor.

Remove the present volume control and replace with a dual shaft 10k/1 meg pot. The knob which is now on the volume control may be salvaged by drilling a hole on thru the knob and using it as the back knob of rf control. The 10k portion of the pot will be hooked back into the circuit exactly as the original single 10k which was taken out. The 1 meg portion of the new pot will then be connected in the grid circuit of the 1st audio stage as per schematic. The spare terminal on the terminal strip just in front of the power plug may be used as the AGC buss, which the end of R-17 will reach. A jumper can be run across to the spare pin on the 6V6 (Pin #1) which will serve as a terminal for the AGC buss line and R-41 (grid of the 2nd if amp V-8).

The only adjustment of the circuit after completion is the setting of the gating pot and the adjustment of the desired delay time. The latter is naturally by choice of the operator. The setting of the gating pot may be accomplished by putting a volt meter across the one mmfd capacitor, turning the transceiver on, and turning it to an unused frequency (Har-de har-har-har) and with the rf gain wide open adjusting the gating pot to a point where the background noise just begins to furnish negative voltage into the AGC buss line. This will be around ½ of a volt, depending upon the amount of noise and band conditions, etc.

Heat up the solderin' iron pordner, let's put a quite-etis to these rear bumper Jokers, TEXAS STYLE—!!!

. . . W5TOC

Parts List

All resistors are ½ watt and all capacitors are 450 volt disc ceramic except the 1 mfd. which is an electrolytic 150 volt.

1—12BA6
1—7 pin tube socket
1—"L" bracket
2—Self taping screws
1—12 inch piece of shielded hook up wire (Single Condr.)
1—.01 Capacitor
1—.02 Capacitor
1—.002 Capacitor
1—.006 Capacitor
1—1 MFD. (Electrolytic)
1—1N538 Diode (Or Equiv.)
1—2 hy. audio Choke (Smallest Current rating available) or Output transformer from old BC radio.
1—2 watt 100K pot
1—Dual 10K/1 meg. pot (Dual shaft)
1—1meg pot (see text) or one 250K ½ watt fixed resistor.
1—30K resistor
1—3K resistor
1—120K resistor
1—500K resistor
1—350K resistor

Hammarlund Equipment at 4U1ITU

Stu Meyer W2GHK, the president of Hammarlund, is here being thanked by the president of the International Amateur Radio Club, John Gayer HB9AEQ for the donation of the Hammarlund equipment for the IARC ham station 4U1ITU. Stu and John were met by our tourers and many operated this fine setup during the big hamfest put on by the IARC.

Jim Kyle K5JKX
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A Medium Power Mobile Rig

In the past several years, two or three articles have explained how to convert specific items of CB (ugh!) equipment for ham-band use. But none, at least so far as the writer knows, have shed any light on how to boost the power levels up to usable amounts for ham communication!

Having converted one of these little transceivers to roar forth 60 watts of well-modulated rf on 10 meters, while still retaining the receiver unaltered, I thought the technique might be of interest to some of the rest of the gang who have acquired such equipment one way or another.

Basically, the conversion consists of adding an outboard final-amplifier stage built around a pair of TV horizontal output tubes, while retaining the built-in T-R switching of the transceiver and providing some way to modulate the heftier carrier which results. The unit described here fills the bill nicely.

But I might as well start by warning that the details won't apply to all CB units. The one converted here was a Kaar 327; any other transceiver having the following features will also work: 1) Relay switching from transmit to receive, *at the antenna connector*. 2) Transformer mudulation. 3) Separate rf amplifier and final tank coils.

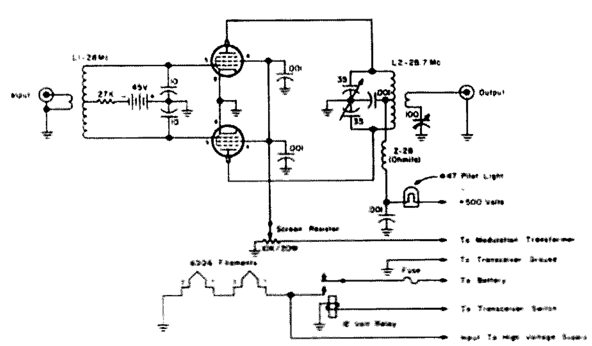

FIGURE 1

Converting The CB Unit

Actual conversion to 10 meters from the 27 mc band won't be described in detail, since it will depend largely on the circuit of the particular rig. The Kaar uses 13.5 mc rocks, doubling, and requires 14 mc crystals to reach the ham band. The receiver is moved over by judicious adjustment of its oscillator trimmer. Various trasmitter coils were pruned slightly for best measured output at 28.7 mc.

After the transceiver is operating properly in the 10 meter band, find a spot on the back panel where you can mount two coax connectors and a 3-contact female socket. These will provide connection and control for the outboard amplifier.

After mounting the connectors, break the lead from the transmitter final output to the T-R relay. Run a new lead from the output circuit to one of the new coax connectors, and a second lead from the other coax connector back to the T-R relay, so that a jumper between the two coax connectors will restore the original circuit.

Then run a lead from the final-amplifier-plate side of the modulation transformer to one contact of the 3 contact socket, and a second lead from the controlled side of the on-off switch to another contact of the socket. The third contact goes to ground.

Make up a jumper for the coax connectors so you can use the unit at low power. This completes the modification of the unit.

The Outboard Amplifier

We begin this section with a description of the outboard unit, so you'll know what's up as we get into construction details.

The outboard amplifier consists of a pair of 6DQ6-G horizontal output tubes, operated push-pull, and screen-modulated. Before you scream about the screen modulation, however, remember that the *driver* is also modulated and the result is consistantly good modulation with greater overall efficiency than is usually thought possible. To get 60 watts out, we put only 100 watts in.

The modulated rf from the transceiver is applied to the grids of the 6DQ6's through a fixed-tuned circuit, resonated slightly lower than operating frequency to avoid the need for neutralization.

The modulated high-voltage also sampled from the transceiver is applied to a variable resistor in the outboard final, and the tap on this resistor feeds the screens. Original plan was to bypass audio from the top of the resistor to the screens, but 100 percent modulation was achieved without this proving necessary so the capacitor was left out.

The final takes its filament and high-voltage from a separate supply. Originally a transistorized supply was used, but heat proved too much for the semiconductors so a PE-101 was substituted. Both the filaments and the HV supply are controlled by a relay, which is actuated by the current taken off from the controlled side of the transceiver switch (lead No. 2 in the connecting cable).

Output from the final is returned to the transceiver through coax, where it is routed to the T-R relay and thence to the antenna.

Since power is applied to the new final at all times when the transceiver is on, 45 volts of fixed bias from batteries is applied to the grids. This holds plate current almost totally cutoff in the absence of drive, and makes T-R switching a simple affair indeed.

Now let's get to some of the details.

The original outboard was built into a 7x13x2 inch chassis, but a 7x9x2 would suffice if you don't plan to include a transistor HV supply. A single Seezak side rail (No. 62) was mounted across the 7-inch dimension inside, with holes punched for the two ceramic tube sockets. This provides almost complete shielding between grid and plate circuits.

The grid circuit consists of a length of Miniductor or Air-Dux supported between the grid pins; the sockets were mounted so that the grid-pin spacing was approximately correct. In the original, this tank circuit was

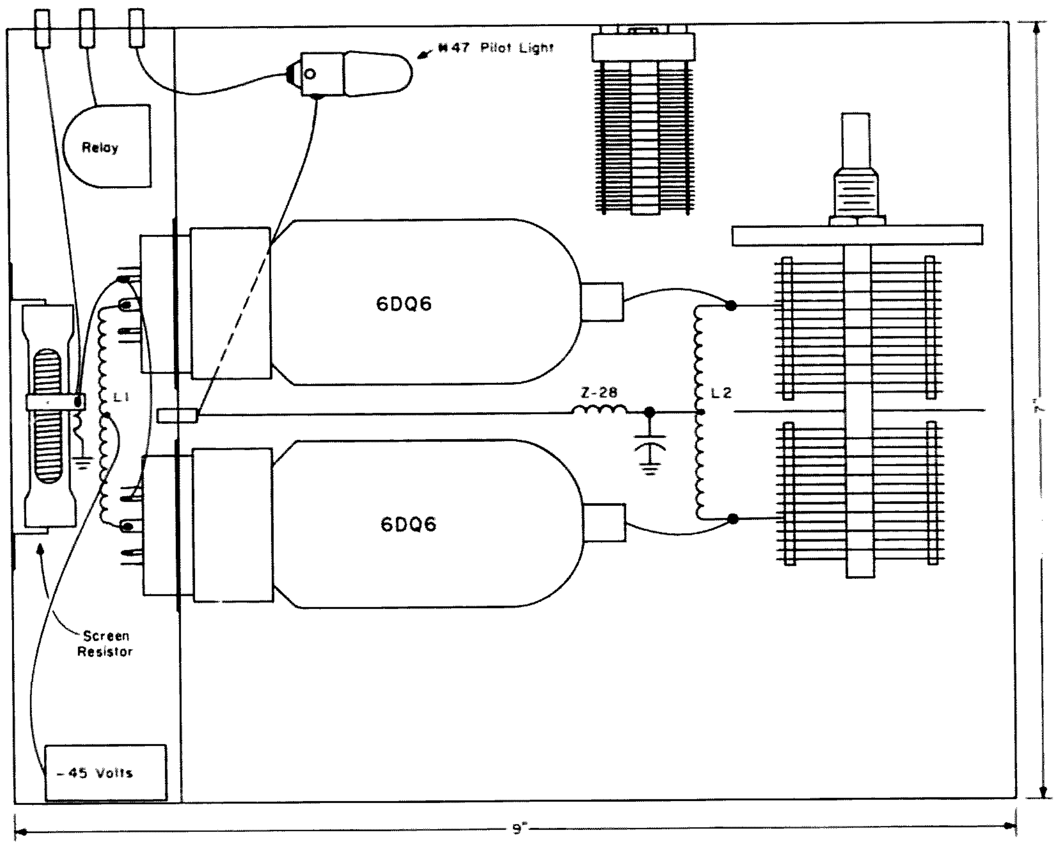

FIGURE 2

Sketch looking down into amplifier, cover removed showing changes required to CB rig.

trimmed to frequency with small ceramic capacitors; it might be more convenient to use a small butterfly variable, thus allowing field adjustment.

The two screen pins are individually bypassed to the cathodes and are in parallel for dc; the common lead goes to the slider of the variable power resistor, which mounts lengthwise across the inside end of the chassis. The two bias batteries are mounted nearby, as far as possible from the resistor however to avoid heat problems.

Cathodes ground directly to the Seezak rail, via solder lugs and self-tapping screws.

A 1/4-inch standoff insulator mounts directly between the two tubes and slightly nearer the chassis; this is the B-plus tie point and is bypassed with a HV ceramic. A lead runs from this to a socket for a No. 47 pilot bulb which serves as a combination tune-up meter and fuse. The hot wire from the power supply or dynamotor comes to the other terminal of the bulb socket.

The plate circuit is located at the far end of the chassis from the Seezak plate. It consists of a split-stator variable (picked for size and plate spacing, from surplus—several models of current manufacture are suitable) and a plate tank coil wound from No. 12 wire to resonate. Flexible leads made from shield stripped from RG-58 connect the ends of the coil to plate caps; parasitic suppressors may or may not be necessary. If posible, leave them off as they reduce efficiency horribly.

An Ohmite Z-28 choke connects the B-plus tie-point on the tube-socket plate to the center-tap of the plate tank coil. The center-tap should also be bypassed to ground as shown on the schematic; another standoff insulator comes in handy here.

Loading is adjusted by a series capacitor in the conventional manner. Coax from both input and output loops runs back to the transceiver. If this coax is properly grounded both at its origin and at the point where it leaves the chassis "case," you should have no trouble with feedback caused by proximity of the leads.

A cover plate to completely enclose rf within the chassis is a necessity, however, and a series of ventilating holes should be drilled in both plate and chassis so as to let air flow past the 6DQ6's. Failure to do this at first resulted in a badly blistered rf choke, as well as a melted-out solder joint or two!

Test & Tune-Up

After checking all the wiring, smoke-test the

unit. If nothing burns, you're ready for initial tune-up.

Start with the slider on the screen resistor set at its ground end; this will hold current in the final almost to zero during the initial stages of test.

Plug in the 3-contact connecting cable but leave the jumper on the transceiver, and re-check its tuning to make sure the addition of the resistor on the modulation transformer hasn't shifted the point of proper tuning.

Next, make all connections. Using a VTVM with isolating resistor, measure dc voltage at either grid pin of the 6DQ6's. It should be appreciably greater than the standing bias voltage; if not, check the grid circuit to find out why.

Assuming you have proper grid drive, the next step is to attempt to resonate the plate tank. Use a wattmeter in the antenna line for this, and be sure the cover plate is on the amplifier (parasitics are almost certain if the plate is off). You will probably get about the same power out as with the transceiver operating barefooted at this point. Set the loading control for minimum, retune the plate, and leave it tuned.

Now you're ready to set the carrier level and adjust the modulation. This is best done with a scope, but can also be done by rule-of-thumb and a wattmeter (that's how the original was tuned).

First, turn everything off and short out the B-plus lines for safety. Now move the screen-resistor slider up to about 1/3 of the way from ground. Remove the shorts on the B-plus, and turn on the equipment.

You should now have appreciable current being drawn by the 6DQ6's, and power output should be somewhere betwen 50 and 80 watts. Load for maximum power output; if the tubes start to glow, pause briefly, and move the screen slider closer to ground. The objective at this stage is to get all settings right for an output power reading of 120 watts—but don't hold it for long as this is above all continuous —duty ratings.

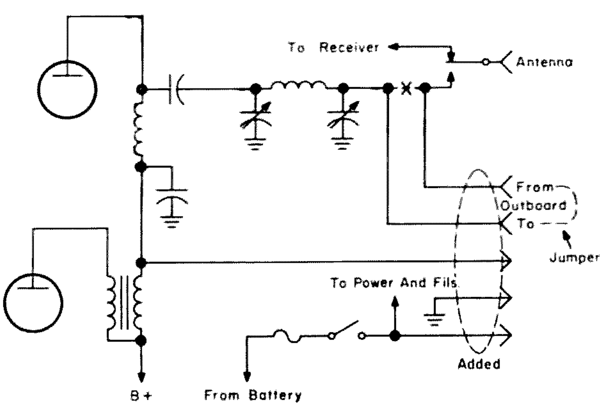

FIGURE 3

Once you get the plate circuit adjusted for 120 watts (or more) lock the loading and plate tuning settings so they won't be moved. Now adjust the screen slider (with power off) so that power output drops to one-half the amount you originally got. Operation at this level gives you 50-percent modulation, with relatively high power. Reducing screen voltage until power output drops to 25 percent of the maximum would give 100 percent modulation, but in practice the 50-percent-modulated 60-watt signal was more readable over a longer range than was the 100-percent-modulated 30 watt signal. In any event, you can take your pick.

From this point, you have only one remaining step. That is to measure input voltage and current to get an input-power reading for your log. Typical values will be 100 watts for the 60 watt output, and 75 watts for the 30 watt output. Then it's up to you. Have fun!

. . . K5JKX

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Transmission Line Tripe and Trivia

I have a strong dislike for experts! That is, the self admitted brand! Any genuine gold-plated expert is generally much too intelligent a character to make any claims of technical superiority. Personally, I prefer to think of myself as a bungler! This statement gives me a great edge over the "experts," as any goof-up I make is covered by my own admission to being a bungler. These preceding statements are made to permit me to vent my rage on the genuine bunglers (alias the Experts.)

It all started several years ago when I became Editor of a Radio Club newspaper. The Club is a moderately large club with a membership of over several hundred. The paper is read locally by dozens of Amateurs who are engineers by profession and education. Needless to say, technical errors bring down a verbal barrage of reproach and ridicule, therefore we try to get several opinions prior to committing ourselves in print. Now in the capacity as Editor, I scan the various Amateur magazines, general electronics magazines, electronic hobbyist magazines and about 30 different Radio Club papers received on an exchange basis. In recent months, there seems to have been a more than usual interest in transmission lines and this is what triggered me off. Some of the statements regarding transmission line phenomena and application border on the ridiculous. The sad part is that newcomers to the hobby read these erroneous statments which are presented in very simple terms and, the weight to their terms being relatively simple and easy to read, accept them at face value.

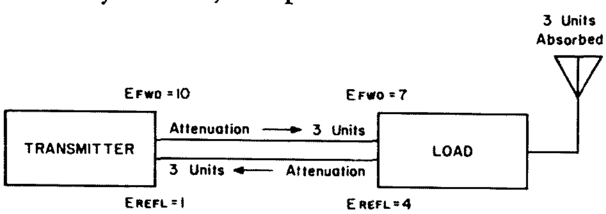

FIGURE 1

Some of them are real corkers! Some are heard again and again over the years. Due to lack of knowledge of the laws of libel, I will omit the actual names of who wrote them and where they were printed. If you have read them in the past, you will possibly recall them and you can check them again for reference.

First, and thank heavens this *was not* in an Amateur publication! The article in question went on at length to tear away the mystery of coaxial lines characteristics impedance by stating: "to measure the characteristic impedance of a line, connect an ohmmeter between the center conductor and the braid and *read the meter closely*". This statement wiped out years of work and reams of transmission line theory. The big calamity is that the author of the article neglected to mention just what kind of super meter he used!

Secondly, the half truth. I quote: "If you have a 52 ohm load and a transmitter whose output circuit is designed to work best into a 52 ohm load, but you have only 300 ohm twin lead available, then cut the 300 ohm feedline to exactly one half wavelength. By doing this, the 52 ohms at the load end will be repeated at the input end and the transmitter's output circuit will be matched. (So far so good, but he was not content and proceeded to really befuddle the issue.) He then stated, "Since the transmitter's output circuit is matched, the SWR will be 1:1!"

Zilch! Dear "expert" has evidently not become acquainted with basic theory which shows that the load is the prime determinant of the SWR. If a 300 ohm line were terminated in 52 ohms, we would divide 300 by 52 and find our SWR was approximately 5.3:1 at the load. No matter how he shortens, lengthens, or decorates his line, the SWR on it will not be 1:1. And while we are thinking in this line, most texts agree that the load is the prime determinant of the SWR with little mention made

that *any* discontinuity in the line will be a contributing factor. In particular: poorly assembled coaxial connectors, damaged coaxial line, sharp bends and cables strung so they collect moisture (which, if it invades the inner workings of the cable, can change its characteristic impedance, and upset the carefully adjusted matching system.) Third. The party responsible for the previous statement also blandly states " that the place to measure SWR is at the generator". Granted that it is usually more convenient to measure it at the transmitter end, as most people do not like to be troubled sticking their heads out the window and reading a meter that is possibly 40 feet up in the air. The SWR at the transmitter can be very deceiving unless properly evaluated. For example, take 300 or 400 feet of cable (RG8/AU) and stretch it out across a field. Feed 50 watts of 2 meter energy into it. At the far end, leave it wide open or drive a nail into it, (take your choice). With it open or shortened, you will have an infinite SWR at the load end. However back at the transmitter, you will find you have a very tolerable SWR. This will bear out the statement that the SWR at the load is always greater than at the generator. So if you don't like your SWR at the transmitter and you also don't care how much you lose in the cable, keep adding line to your heart's content. Your SWR will go down, also your signal! Here is a little proof by pictorial analogy! VSWR is defined as the ratio of the voltage maximum to the voltage minimum on the line. E maximum is defined at the incident voltage (E forward) plus the Reflected Voltage (E reflected). E minimum is the E fwd minus the E refl.

Therefore VSWR equals

$$\frac{E_{MAX}}{E_{MIN}} = \frac{E_{FWD} + E_{REFL.}}{E_{FWD} - E_{REFL.}}$$

Fig. 1 shows roughly how the incident or forward voltage is attenuated in travelling from the transmitter to the load and vice versa for the Reflected energy. The figures used are an approximation to avoid the use of formulae involving losses up and down a line.

In Figure 1, if we have 10 units of forward voltage and the attenuation of the line consumes 3 units, then we have 7 units of E fwd arriving at the load. If the load is a poor match and absorbs only 3 units, then 4 units are rejected. On the return trip, the 4 units are attenuated and drop to a magnitude of 1 unit on arrival at the transmitter. Applying these figures to the formula, we arrive at the following results.

$$SWR = \frac{Emax}{Emin} = \frac{10+1}{10-1} = \frac{11}{9} = 1.2:1$$

Transmitter end

$$SWR = \frac{Emax}{Emin} = \frac{7+4}{7-4} = \frac{11}{3} = 3.6:1$$

Load end

What our friend might have done was to have qualified his statement and said that at frequencies below 30 mc/s where short runs of cable were involved, since attenuation figures are relatively small at the lower frequencies, then for most practical purposes, the SWR at the transmitter would be approximately that at the load end. BUT not in the VHF range Brother!

And still another faux pas. Why do characters persist in talking about pruning the line length to lower SWR? This has always been a tough one to combat because an unenlightened "line pruner" can quote circumstances where better transmitter loading occurred after the pruning." No argument on this part of it, since he merely found a length of line and a cable input impedance which was a little more to the liking of the transmitter's output circuit. But he certainly was not watching his SWR bridge! With the advent of inexpensive SWT Bridges in the past few years, the elimination of this particular irritation may soon be at hand.

And another. In one article which was very well written, the author made several fine contributions to the art and then fluffed on a basic point. Said he "any amateur knows that a transmission terminated in its own characteristic impedance will reflect that impedance at 180 degree (half-wavelengths) intervals." Bravo! But how about the points in between? The beauty of terminating a line in its own characteristic impedance is that at *any* point, *any* distance from the load on the line, the impedance seen will be purely resistive and equal to the characteristic impedance of the line.

Classroom trickery! For the past several years I have held a position where the teaching of transmission lines was among my assignments. To demonstrate pointedly to my classes (which incidentally often include graduate engineers) I toss a statement on a True or False basis. "A transmission line repeats itself every 180 degrees" and then wait for the storm when I point out that the statement is False. The basis of my trick statement is a concept used in the analysis of a theoretical line. That concept states " A transmission line will repeat itself impedance wise every 180 degrees *if the line is lossless*". What is it that does not repeat? Well how about the phase of the voltage? There will be a 180 degree reversal. How about the SWR on a practical line? Since the SWR is greater at the load, then as you move away from the load the SWR will decrease.

Tripe and Trivia! Well maybe so but it seems to me that it is almost a duty to meet some of the tripe head on and, trivial or not, do our best to see that some corrective action is taken.

. . . W5EUL

Modularization

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In the far-out reaches of advanced military-type electronics research, one of the "magic phrazes" is the simple word "modular".

In case you missed the excellent discussion of modules and their uses in ham radio which W5WGF authorized in the February 1963 issue (page 40), we'll run through again just what a modular design consists of:

You're probably familiar with a block diagram as opposed to a schematic. Now if each "block" on the diagram happened to be built on a different chassis, and the chassis were so arranged mechanically that they could be easily interconnected, you would have a collection of modules. Each module has its own purpose, and they can be interconnected in almost any way you can imagine.

The earlier article on ham use of modules explained in some detail how to put large chunks of circuitry on compact subassemblies

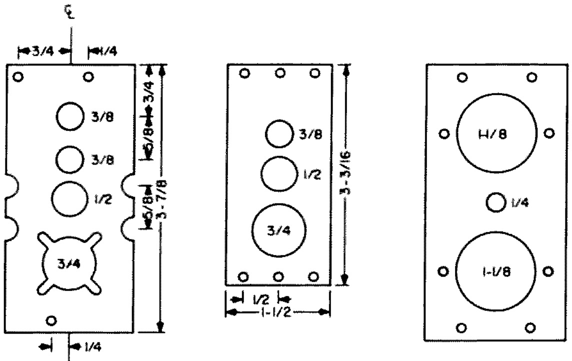

FIGURE 1

Module plates

and interconnect several of these subassemblies into a complete functional unit. For example, one module consisted of an oscillator-buffer providing output at any frequency from 24 to 72 mc; a second module was a 48-54 mc amplifier driven by the first; while a third was a 48-to-144-mc tripler to be driven by the second. This approach to modules is an excellent one.

But for the compleat experimenter, a more rigorous approach to modularization might be in order. This approach is more like the military version, where each module has its simplest possible form.

An rf amplifier module, for instance, might consist merely of the tube and its associated biasing resistors and bypass capacitors. The coils are on two other modules; in this fashion, the rf amplifier module can be used from 100 kc to 100 mc with no modifications!

While this approach has not been pushed to any extent in the ham field, at least one firm is currently marketing such modules (International Crystal's "Add On Circuits"). And they're not difficult for any experimenter to put together for himself.

Fig. 1 shows three possible forms such modules can take so far as their chassis plates are concerned; chassis dimensions are one of the key points when working with modules, since each module must be able to fit in with every other module in the collection.

The "Neale Plate" in Fig. 1 is a design originated in England; the ¾-inch hole takes a 9-pin socket or a 7-pin wafer socket having 1-5/16" mounting holes, the ⅜ inch holes are for pots or coil forms, and the ½ inch hole is for a toggle switch.

The "Int.AOC" plate is an adaptation of the International plate; outside dimensions are identical with the commercial modules, while the holes allow mounting of the same components which fit the Neale Plate.

Finally, the "2x4 Octal"plate is designed for use solely with Octal sockets; to use 7 or 9 pin sockets, you could either substitute smaller holes, or drill through some 1-⅛ inch hole plugs which could then be put in the holes on the plate.

If metalwork doesn't appeal to you but you like the thought of modularizing most of the more common block-diagram circuits, you might investigate See-Zak "Special Electronic Parts" which are produced by Rimak Electronics Inc., 10929 Vanowen Street, North Hollywood, Calif. Most of us are familiar with their expandable chassis—but they also produce a line of breadboard modules, including a "Started Kit" containing samples of all their breadboard module plates and priced at $16.98. Some of the plates in their line include meter mounting plates for meters as large as 3-inch size, relay-rack mounting adapters, and insulated terminal-strip plates.

To put together a set of modular "building blocks", one of the first steps would be to decide whether you prefer to start with rf or audio. If audio is chosen, a couple of low-level amplifier plates, one medium-level driver, an assortment of phase inverters, and several power-amplifiers stages (up to say 50 watts push-pull) will provide you enough experimental material to breadboard modulators and/or receiver audio from now on.

If rf is chosen, a half-dozen standard rf/if amplifiers, less all frequency-determining components (see ARRL handbooks for circuit) provide a good starting point. Two or three mixers, a handful of detectors, a batch of coupling-coil plates, and an oscillator or two complete the lineup for breadboarding receivers.

For transmitters, you may find it more convenient to include the plate coil on the module plate; to have a good collection of modules in this field, at least one oscillator and three or four frequency-multiplying plates should be available. Final plates in power levels ranging 5 to 150 watts are also advisable. Differential keyers, VOX circuitry, and similar accessories can be modularized as desired and added to the collection.

If you need circuit ideas to help fill these module plates, go through the back issues of 73 and study the Big Technical Articles which have appeared more or less regularly since the second issue of the magazine; most of these circuits are ideally suited to the module approach, though a few are more integrated.

And when you have your module collection going full blast, and work up some interesting combinations, drop a note to Wayne; who knows, your modularization might pay off!

. . .K5JKX

Transceiving High Level Mixer

Wilbur Notbohm W2KPC
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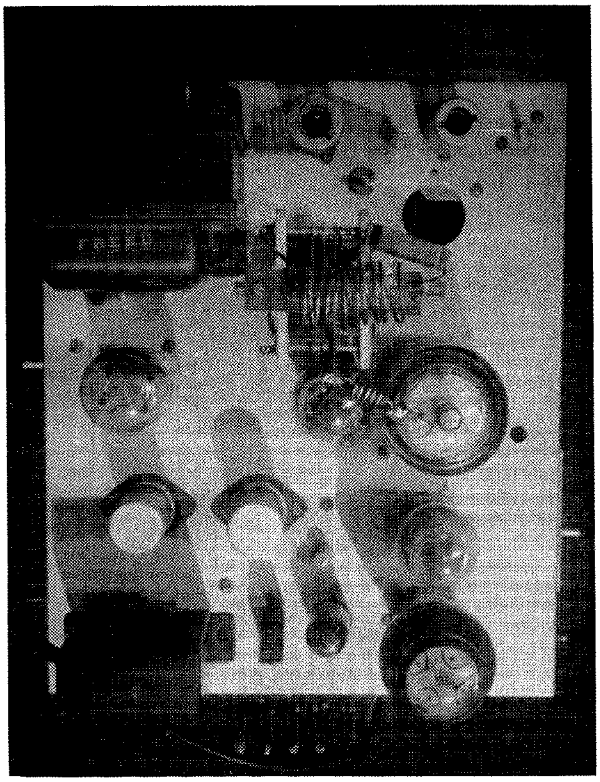
Stuck on one band? Or three? No need to be, as the author easily found out. The transceiving hi-level mixer described is presently used with a three band Swan to get on ten, for local rag chewing. It was also tried on 15 and worked equally well. Future plans call for band switching this unit to cover 10 and 15, and another for 6 and 2. No changes were made in the Swan. The power supply for the Swan is home brewed, and when used with this mixer, the high voltage for the 6DG5 is dropped to 400 volts According to the manufacturer it could be as low as 260 volts. Reduced input to the final is desirable. With 400 volts on the final and with carrier (in tune position), it is loaded to 150 ma, about 60 watts pep. The audio gain is set about position 4. Most one and three band transceivers can be loaded to a reduced input, and with reduced audio gain drive this mixer. A pad might be needed for additional attention with some transceivers. If your transceiver has AM output like the Swan, this mode of modulation was tried and it works. It is not expected that it will be duplicated per se but that it will stimulate some of you to get out the old pencil and paper and work up other combinations. A better choice of tubes and components might be warranted, but my source of supply was the junk pile.

Let's take a look at the circuit. One-half of a 12AT7 is used as a crystal oscillator. Its plate

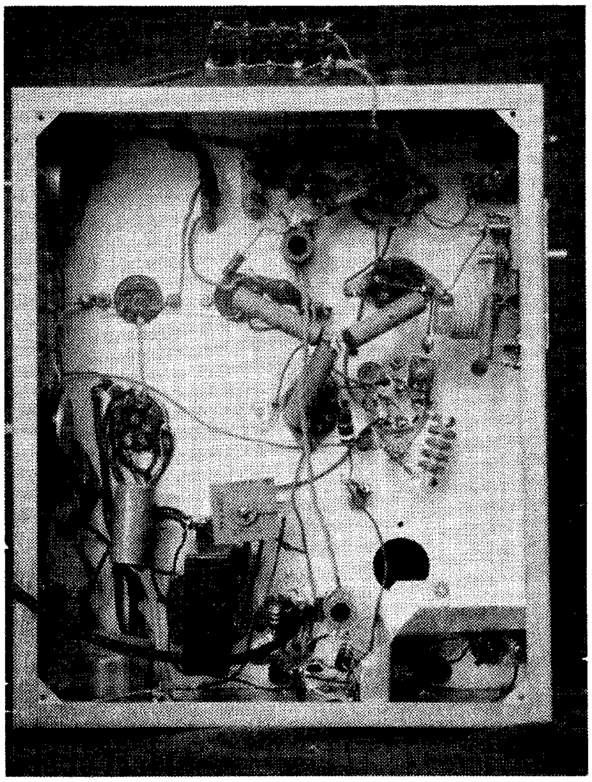


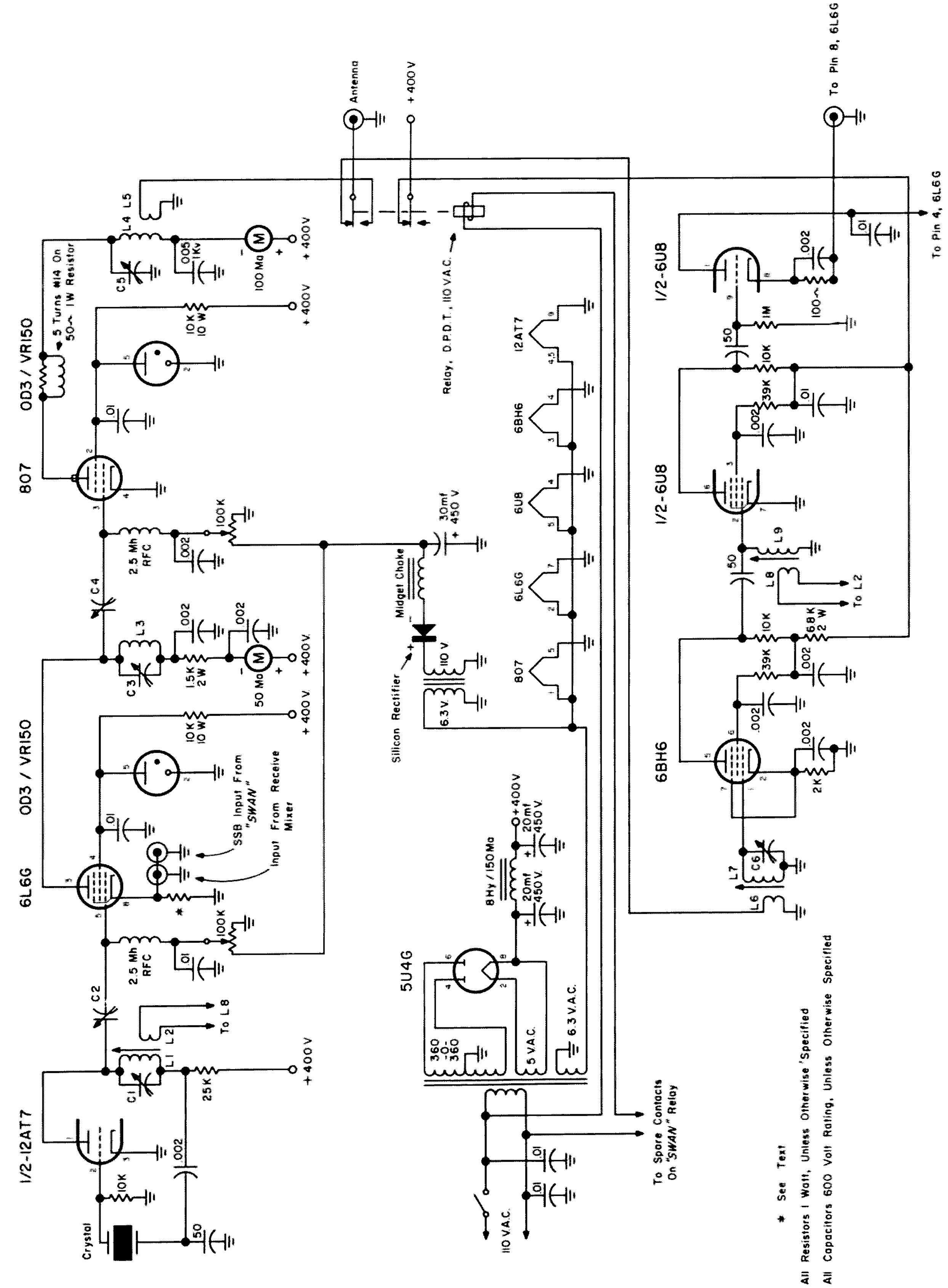
circuit is tuned to 21,450 kc, the third harmonic of the crystal frequency, which is 7150 kc. The output of the oscillator is capacity coupled to the grid of the 6L6G used as the transmitting mixer. 40 meter sideband output from the Swan is fed to the cathode of the 6L6G. On forty, the Swan has a range of 250 kc, tuning from 7050 to 7300 kc. These frequencies, when added to 21,450 kc in the mixer, give 10 meter output in its plate circuit. The plate circuit therefore tunes from 28,500 to 28,750 kc, in which range most 10 meter sideband activity takes place. A change in crystal frequency could extend the useful range. The 10 meter output of the mixer drives an 807 tube as a class AB 1 linear 12 to 15 watts pep. Increased output could be had by raising the screen voltage on the 807 which at present is 150 volts regulated.

When receiving, 10 meter input from the antenna is amplified by the 6BH6 tube. The amplified signal is then fed to the grid of the pentode section of the 6U8 tube, which acts as the receiving mixer. 21,450 kc output from the oscillator is fed to this same grid. Link coupling is used with a pair of twisted leads as the transmission line. The difference between 21,450 kc and the 10 meter signal will produce a 40 meter signal in the plate circuit of the 6U8 pentode mixer. The received signal will now be on the same frequency that the Swan is putting out, true transceive. Output of the pentode receiving mixer is fed to the grid of the triode section of the 6U8 tube, which is used as a cathode follower. A cathode follower was used to obtain a better match of impedance between the output of the receiving mixer and the input to the Swan, a high to low impedance combination. A tuned circuit with link coupling would give higher output—but as I will explain later, would limit the usefulness of the unit. Output from the cathode follower is coupled by a short piece of co-ax to the cathode of the transmitting mixer. This means of course that it is connected to the input of the Swan. The output of the receiving mixer and the input to the transmitting mixer are one and the same point. No switching is needed. Switching is needed to transfer the antenna from the 6BH6 input to the 807 output when transmitting and to disconnect B+ from the 6BH6 and 6U8 tubes when transmitting.

Two important points about this circuit make it especially adaptable to all transceivers. 1) No tuned circuit is used between it and the driving unit on transmit. 2) The output of the receiving mixer is also untuned. This means that single band transceivers with output on 80, 40, or 20 can be used if the proper crystal frequency or harmonic of it is chosen so that the sum or difference falls in the new band desired. However, with a 20 meter unit to get on 10, the difference frequency should be used. Remember when the sum frequency is used the sideband is unchanged; when the difference frequency is used, the sideband is inverted.

A 10 x 12 x 3 aluminum chassis was used




1/2-12AT7
6L6G
OD3 / VR150
807
OD3 / VR150
5 Turns #14 On 50~ 1W Resistor
Crystal
2.5 Mh RFC
100 Ma
50 Ma
+400V
SSB Input From "SWAN"
Input From Receive Mixer
To L8
To L2
Antenna
Relay, D.P.D.T., 110 V.A.C.
Midget Choke
Silicon Rectifier
5U4G
8 Hy / 150 Ma
110 V.A.C.
To Spare Contacts On "SWAN" Relay
6BH6
1/2-6U8
To Pin 8, 6L6G
To Pin 4, 6L6G
* See Text
All Resistors 1 Watt, Unless Otherwise Specified
All Capacitors 600 Volt Rating, Unless Otherwise Specified

for construction, simply because it was handy. A study of the photos will show you that it could be easily compacted. The layout isn't critical; previous holes in the chassis influenced the positioning of components, and no particular bugs developed. Shielding of the receiving rf amplifier circuit is necessary. A partition and bottom cover were put around it. A piece of co-ax or shielded cable is necessary betwen the cathode follower output and pin 8 of the 6L6G. Make the exposed portion of the leads as short as possible. The 50 ohm resistor in the cathode circuit of the 6L6G mixer is the load into which the transceiver develops its output. This resistor must be non-inductive and capable of dissipating the output of the transceiver used. A study of the photos shows that the resistor used was outboard. It is made up of 40, 2000 ohm 2 watt resistors in parallel, left-over from some previous experiment. As the mixer is operated here, no heating of these resistors is evident. If an outboard resistor is used, it is recommended that it and the leads used be shielded. Remember this is the output and input point of the transceiver. A relay isn't shown in the photos because it is external at this QTH. It should be located near the 807 output tank circuit so that one end of L5 can be connected to it. The co-ax fitting for the antenna should be close to the relay. A piece of co-ax should be used between L6 and the relay. Locate the co-ax fitting for transceiver input as near to pin 8 of the 6L6G as possible.

Immediately after power is applied adjust the 807 bias pot so that its plate current is 15 ma. Remove the crystal and adjust the 6L6G bias pot so that its plate current is zero. Reinsert the crystal. Set CI near maximum capacity. Adjust LI and C2 for maximum 6L6G plate current. It may be necessary to readjust CI. Check with a wavemeter to see that the oscillator plate circuit is tuned to 21,450 kc.

Now feed 7050 kc sideband input from the transceiver. The Swan is adjusted to 60 watts pep input. (400 volts 150 ma). It develops its output in the 50 ohm resistor in the 6L6G cathode circuit. This is done with the Swan in the tune position. Adjust C3 for maximum 807 plate current (about 40 ma). Adjust C4 for maximum 807 plate current. It may be necessary to readjust C3. Check with a wavemeter to see that the 6L6G plate circuit is tuned to 28,500 kc. C3 should be near its minimum capacity. Adjust C5 for minimum 807 plate current. C5 should be near its minimum capacity. Connect the antenna and readjust C5 for minimum 807 plate current about 50 ma.

Turn the Swan to the transmit position (no carrier). Readjust the bias pots so that the 6L6G plate current is 10 ma, and so that the 807 plate current is 15 ma. Set the audio gain to position 4, push to talk, and speak into the mike. The final plate current should kick up to at least 40 ma. The 6L6G plate current will barely flicker. You are on the air.

When the push to talk button is released, the receiving mixer is functioning. If you have a signal generator set it to 28,500 kc and peak L7 with C6 set about its middle value; also peak L9. Without a signal generator it is possible to peak these with noise pick-up and then readjust on a weak signal. The received frequency will be on the same frequency as your transmitted signal.

Many local contacts have been made with this mixer and Swan combination. The reports and comments made very favorable. The 10 meter results proved the signal quality and stability were equal to that on the lower bands. While aligning the receiving section, several Florida and Texas stations were heard. Most tests and checks were made by prearranged schedules. I wish to thank my good friend Joe K2IQZ for his time spent listening and testing with me. Tired of QRM? Get on ten, it does open up but you have to be on to get it. It's an ideal band for local rag chewing. Try this mixer, don't underrate its possibilities, especially with a good antenna. Let's hear some more of you fellows on ten, USB *and* LSB . . .

. . . W2KPC

Parts

L1—15 T #20 E close wound on National XR-50 slug tuned form
L2—1 T hook-up wire, near old end of L1
L3—8½ T #14 dcc close wound on ¾ dia. polystyrene
L4—10 T #14 E 1½ L, air core, ⅞ id.
L5—2 T #14 plastic covered, ⅞ id., insert between L4
L6—2 T #20 plastic covered over cold end of L7
L7—19 T #24 E close wound ⅜ dia. slug tuned ctc ls5
L8—17 T #24 E close wound ⅜ dia. slug tuned ctc ls5
L9—1 7 hook-up wire near cold end of L8
C1, C2, C6—3-30 mica trimmer
C3—35mmfd max. var. cap. double spaced
C5—35 mmf max. var. .003 spacing
S. R.—Selenium Rectifier 75 ma
T1—T. V. Transformer 200 ma
T2—6.3 volt 1 amp. fil. trans.

An Electronic Filter Capacitor

or, What won't they trasistorize next?

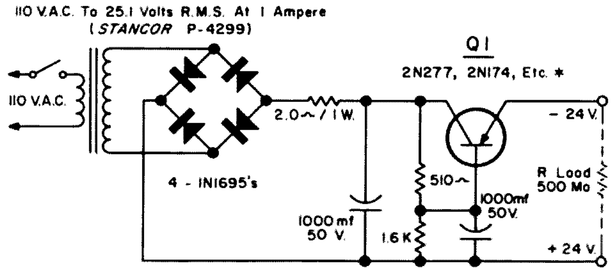
Fred Haines W2RWJ

When I first heard about it, I thought it was one of those April Fool jokes. When I saw it demonstrated in the lab, I changed my mind in a hurry; it really works!

A survey of the power supply section of a handbook will reveal that a power supply is easier to filter if the load current to be drawn is small. As the load current increases, the size of the filter capacitors must increase if the ripple is to remain the same. It would be nice indeed if a new circuit could be devised that would be able to magnify the effect of a small capacitor and make it act the same as a larger one. For one thing, capacitors of the electrolicorice type are expensive, and for another, they are rather large.

The circuit to be described here does just what we have been discussing, and has been called a "capacitor multiplier". It works so well that usually even the filter choke may be thrown out, and in high current drain supplies too.

In the circuit diagram, notice that the transistor is conected from the output of a conventional silicon rectifier bridge to the load, represented here by a resistor. The transistor base is biased by R1 and R2, connected in a divider across the supply potential. The key here is the 1000 mfd electrolytic C2 from base to the plus side of the supply. This is the capacitor whose value the transistor "multiplies". The multiplication factor is the dc current gain of the transistor, sometimes called the Beta.



* Must Be Mounted On A Properly Designed Heat Sink.

NOTE: Either + Or − Can Be Grounded.

A simple formula can be used to describe the action of the circuit. $C_{eff} = C_{actual} \times$ Beta, where C_{eff} is the effective filter capacitance across the output of the supply, C_{actual} is the value of capacitor in the transistor base circuit, and Beta as we have mentioned is the dc current gain of the transistor.

The dc current gain of a typical power transistor at say ½ ampere is 50. This means that a 1000 mfd capacitor in the base circuit will provide the same action as a 50,000 mfd filter across the output of the power supply! If you don't think that's much, go to your catalog and price a 50,000 mfd, 50 volt electrolytic. If you buy one, try to find room for it on that crowded chassis.

The supply in the diagram can deliver up to 1 ampere at 24 volts dc output. The R1 shown is for an output of 500 milliamperes. To obtain an output of 1 ampere, change R1 to 200 ohms and change CI to 2000 or 2500 mfd at 50 volt rating.

The figures I obtained from this supply in the lab are as follows:

Volts Output Normal	*Current Output*	*Ripple Volts At Full Load*
24	0.5 ampere	1.5 millivolts
24	1.0 ampere	1.0 millivolt

The output voltage can be varied by use of a different transformer and a different transistor bias network. The bias should be such that the transistor has between a volt and 3 volts from collector to emitter at full load. In addition, the bias network must be relatively low inpedance as shown here.

Don't forget that the power transistor must be heat sunk! That is, it must be properly mounted to a metal heat sink plate and properly insulated with a standard mica or anodized aluminum washer. See the article "Let's Regulate" in the March 1963 issue of 73 magazine. The electronic filter can also be used most successfully following a transistorized voltage regulator as described in the article mentioned above. Remember, the circuit described here doesn't regulate, it just multiplies.

I intend to experiment with the circuit to find out if it works with smaller capacitor in supplies requiring less filtering, due to lower current drains. It would be nice to be able to multiply a 1.0 mfd unit to a 50 mfd unit for a transistor power supply capable of delivering say 100 ma or less. The space savings could be dramatic. For low current applications, smaller transistors could be tried too, like the 2N1038 series.

Try this device soon, it's quite amazing, and useful as well.

. . . W2RWJ

More Gain for the SX-140

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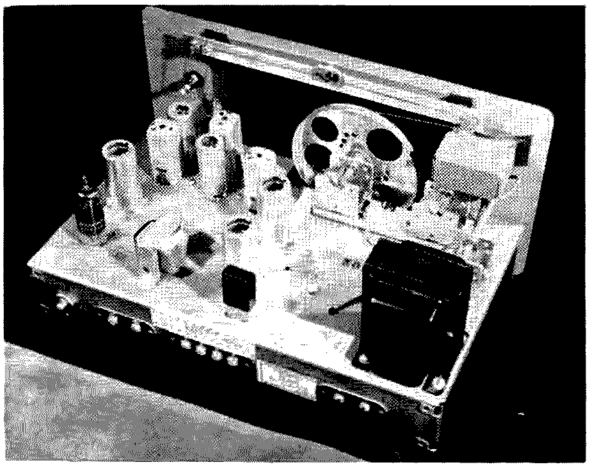
New York 25, N. Y.

In the relatively short time which has passed since its appearance, the Hallicrafters SX-140 has become a very much respected little receiver. It is, or at least was at the time of its introduction the only receiver in the $100 price range to provide ham-band-only tuning, as well as a tuned rf stage, built-in calibration oscillator, as well as several other convenient features.

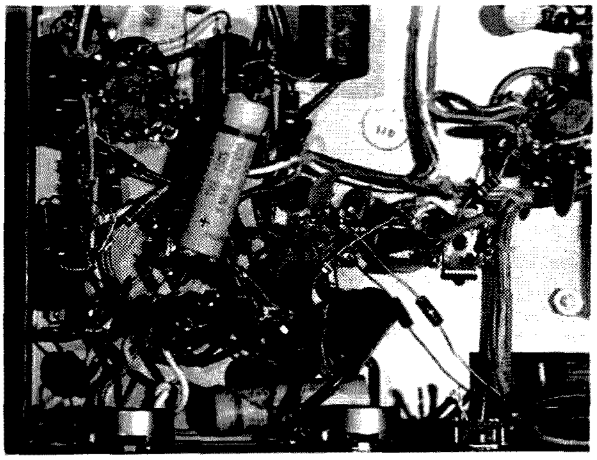
After considerable use of the SX-140 I decided to see what I could do about getting a bit more gain before the second detector to



give the receiver more hop and make the S-meter more generous. I looked the schematic over for opportunities for improvement, and checked the chassis for room for added components.

I decided that my problem was one of overall gain, not signal to noise ratio. If it had been the latter, curing the problem would have meant redesigning the front end, no easy task. Happily, the rf stage in the SX-140 is a model of efficiency, behaving second only to a cascode dual triode on 6 meters, and as well as anything on the lower bands. Therefore, it seemed obvious that what I needed was another stage of amplification somewhere along the line.

The *if* amplifier of the SX-140 incorporates a selectivity control, which at the CW end of its rotation puts the stage into oscillation, providing a bfo for CW and SSB reception. Obviously, this stage was being used to maximum advantage, and I could not possibly get another db of gain from it. However, it struck me suddenly, as I was looking through some catalogues, that the main difference between the SX-140 and quite a few receivers in the



$200 bracket was that the more expensive receivers used two *if* stages to the SX-140's one, albeit regenerative.

The solution was suggested immediately, and it turned out to be most sucessful. I added another *if* stage to the SX-140, basically the same as the original one, but without, of course, the selectivity-bfo circuitry.

A letter to Hallicrafters brought back an *if* transformer (I couldn't find one for 1650 kc in any parts catalogues). A trip to Cortlandt Street brought back a tube, a socket, and a few resistors and capacitors, and I was ready to take the irreversible step: putting the hacksaw to the chassis.

To understand the placement of the new components, refer to the picture of one corner of the underside of the chassis. In the original, the upper (meaning closer to the front of the chassis) tube and transformer are not present, and the signal goes from the mixer to T2, to the *if* amplifier, to T3, and to the detector. In the modified version, the first (original) *if* amplifier feeds the new Ta (closest to the selectivity-bfo control) which, now being the interstage *if* transformer, feeds the new Va (second *if* amplifier, and tube closest to the audio gain control). Va feeds T3, which goes, as before, to the detector.

All of this is explained in the schematic (Fig. 1). All new components are enclosed by the heavy lines, and broken connections are indicated by a heavy "X". It is clear that V3 has been rewired so that it is feeding Ta rather than T3, T3 now being fed by Va. Components Ca and Ra are inserted to isolate the first *if* stage from the avc line; a similar circuit (Cd, Rc) is used for the second stage. These are to prevent feedback and possible self-oscillation through the avc line. For a similar reason, the new *if* stage is isolated from B plus by a circuit (Rb, Cb, Cc) similar to that used in the original stage.

The new *if* stage is designed for high gain

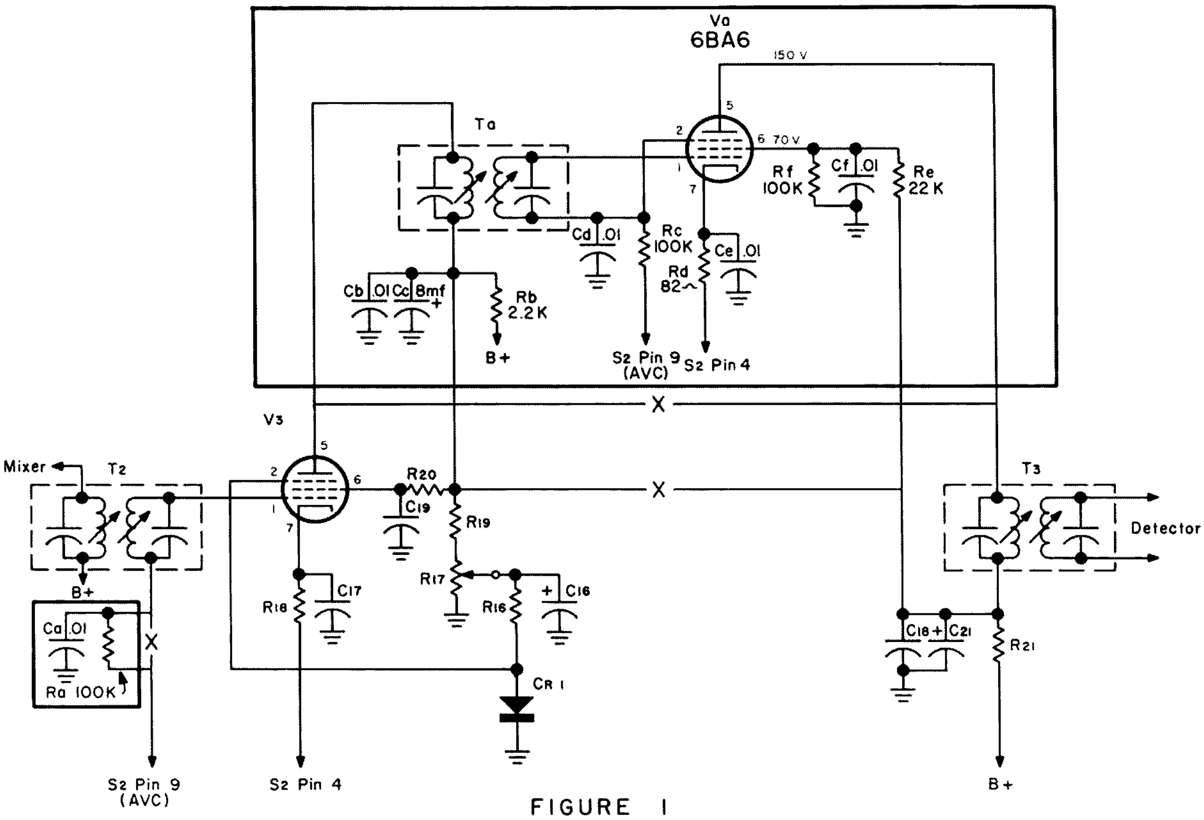


FIGURE 1

and as much reaction to avc as possible. A voltage divider, rather than just a dropping resistor is used to feed the screen to prevent screen voltage from rising in the case of low screen current (high avc) and thereby negating some of the effect of the avc. For good measure, grid 3 is also returned to the avc line.

A few notes on mounting and wiring: refer to the picture of the top of the chassis as well as the bottom. The position of the new components is not really critical, but take care to keep clear of the tuning knob shaft and the dial cord. For the transformer mounting hole, I used as a template a transformer mounting wafer from the junkbox. If you can't find one, it is a good idea to spend the few cents to get one. Trying to judge the oddly shaped holes by eye will invariably result in a few more gaps and scratches than are necessary. When wiring, keep all leads, especially those on the

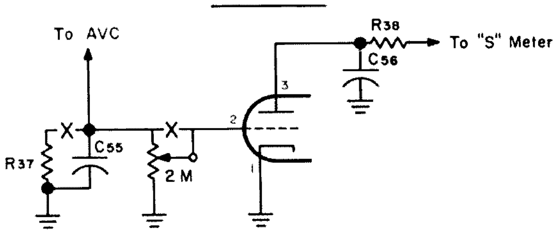


FIGURE 2

many .01 mfd bypass capacitors as short as possible. A one-terminal tie strip is used for the junction (avc end) of Ra and Rc.

Alignment procedure is exactly as it was, except that one more transformer is now included in the sequence. It is possible that, because of the increased gain, use of a 1650 kc crystal in the calibration oscillator circuit may overload the *if* circuit. In this case, you must use an external generator.

While adding the extra *if* stage, I decided to shield all of the tubes except the output-S-meter amplifier. The mounting rivets on the tube sockets are easily drilled out, and tube shield bases installed with 4-40 hardware. Shield the output tube only if you collect cracked 6AW8's.

The additional *if* stage changes the SX-140 from a receiver which is a good value for the money to one which is really a pleasure to use. Bands, which were relatively quiet before, really come alive. I had been somewhat worried about the chances of the first *if*, when in a state of bfo-producing oscillation, overloading the second *if*. Luckily, this never came about. Operation of the receiver is the same as it was previously, although everything seems to work a bit better. AVC action holds signals a bit steadier, and the S-meter really moves. A note about the S-meter: I have always felt that S-meter readings were purely

relative, and that reporting an 85 db over S9 signal would send the other party in a QSO into a state of bliss. However, if you attach a particular meaning or mystical significance to S9, replace the grid resistor of the S-meter amplifier with a potentiometer (see Fig. 2) and adjust for any amount of swing you desire.

. . . W2HTN

Parts List

Ca, b, d, e, f—	.01mfd. 400v disc.
Cc—	8mfd. 400v electrolytic
Ra, c, f—	100K ½w 10%
Rb—	2.2K ½w 10%
Rd—	82 ohm ½w 10%
Re—	22K ½w 10%
Ta—	1650 kc if xformer (Hallicrafters part no. 050-000751)
Va—	6BA6

"Rig hr is Homebrew, OM"

Robert Swearengin W5HJV
Box 26
Duront, Oklahoma

"Rig hr is homebrew OM." I cringed. The hated words, fraught with superiority and contempt for my store-bought rig, burned to the very depths of my being. I cursed inwardly as I remembered the good signal report I had given the transmission before.

I flipped the switch and sent his call six times. "Sorry OM, unable to copy . . . ur sigs now 447 . . . 73 and hope U get ur rig straightened out. That should give him something to think about," I muttered.

I glared at the gleaming transmitter on the operating desk, and knew I was through; a downtrodden victim of amateur radio's most vicious class system.

Fishing a radio magazine out of the cluttered bookcase, I ignored the saucer full of cigarette butts which my elbow knocked on the rug, and flipped idly through the pages. A quick sale of the rig and I could make those much needed improvements on my stamp collection. The neighbors would stop complaining about TVI, the XYL and I could get acquainted again, and . . . the pages flipped over to a schematic diagram and parts list.

"Hmmm . . . single 6DQ5 and not too many big words in the text . . ."

I had to try it.

The days that followed were a beehive of activity, and I was caught up and intoxicated

by the fascination of the creative process. There were difficult times, yes, but the thought of being one of the chosen few spurred me on to even greater heights. I found myself leaving the office earlier each day in order to devote more time to the project. As time wore on I began to lose weight, and developed a pinched look about the eyes from the many hours of staring at the bargain sections of catalogs.

As my junkbox and savings account decreased, I became crafty and learned to scrounge mercilessly. My parents are still wondering what happened to the rubber feet on their portable record player, and local hams now require me to weigh in and out when I visit their shacks. Also, by special order of the engineer in charge, I have been forever barred from entering the electronics department of the local college.

After what seemed like years, I sat at the operating desk and gazed at the 6DQ5 rig with misty eyes. It was ready to go on 80, 40, and 20. "Nobody works the higher bands anymore," I said to myself, "And besides, I can't afford to waste any more time fooling with parasitics and neutralization." My vocabulary had now expanded to include some of the more impressive ham radio type words.

Pride of ownership in the new rig was short lived. The thrill of sending "Rig hr is homebrew" was offset by mediocre signal reports received from stations contacted. "Smart alecs with comercial gear," I told myself, but inside I knew there was only one solution . . . HIGH POWER.

Now that I was experienced, it was a breeze to throw together a pair of grounded grid 811A's for 80, 40, 20, and 15. It worked FB, too, except that the scrounged variable didn't have quite enough capacitance for 80, the final overheated on 20, and the parasitic chokes blew on 15. But then 40 meters has always been my favorite band anyhow.

Well . . . guess that's about the full story, and things have worked out pretty well over the long haul. Since my business went bankrupt, I've had plenty of time to devote to forty meters, and I'm able to buy a few surplus parts for my latest projects out of my unemployment check.

Maybe you'll hear my rig on the air one of these days. If you do, give me a call and I'll give you the construction details. But leave your selectivity switch on the broad position. . . VFO hr is homebrew OM.

. . . W5HJV

Superhet or Regen?

Gus Gercke K6BIJ
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Weimar, Calif.

Proponents of the Stanley Steamer claim that automotive engineers might have gotten further with engines for cars if they had put their millions of dollars of development into steam instead of internal combustion. They might be right. Many electronics engineers, not quite so hung up on orthodoxy as others, feel the same way about regenerative receivers as opposed to superhets.

We have to admit that superhets have had a lot more enginering than regens, and it is just possible that this is one of the reasons that we don't today have regenerative receivers that are as good as superhets. The experimenter who wants to work with regens finds out that the parts required are different from superhet parts and are either hard to find or don't exist.

The characteristics of transistors make them much more promising for regenerative circuits than tubes and it is possible that once we get over "tube thinking" we will be able to work up some really good circuits. Here are some of the factors that I found important in playing around with a transistor regen circuit.

Regeneration control: often a headache; regeneration is not smooth but comes in with a "plop". This is only an indication of a wrong design—wrong voltages, wrong number of turns on a "tickler", or the "tickler" is too close to the base coil. The "plop" can *always* be eliminated with a little experimenting.

Your variable condenser makes noise near regeneration point and produces unstable conditions around weak signals. This is a result of

rubbing of metals between your rotor and the condenser frame (sliding contact, metal ball bearings). At maximum sensitivity even the best condensers will do it and are therefore useless. The only exception is a "butterfly" with insulated rotor and Pyrex ball bearings (Hammarlund "VU" Type) Their capacity is too low for most applications, so—other means of tuning your tanks are necessary. You can minimize this effect by making your variable capacity a fraction of total tank circuit capacity; this will lower your tuning range.

The loading or pulling effect makes it necessary to readjust your regeneration control and/or antenna coupling as you tune across the band. This readjustment will considerably affect your tuning, will often result in losing your station, and will make any accurate calibration of your dial impossible. This can be eliminated by using a small antenna that has no resonance spots near your frequency, or by using an RF stage with untuned output (you will get little gain but the "pulling" will be gone).

The frequency changes as you adjust your regeneration control. This happens with transistors only, and is a result of changes in the interelectrode capacity due to changes in voltages. Trouble of this kind is eliminated by

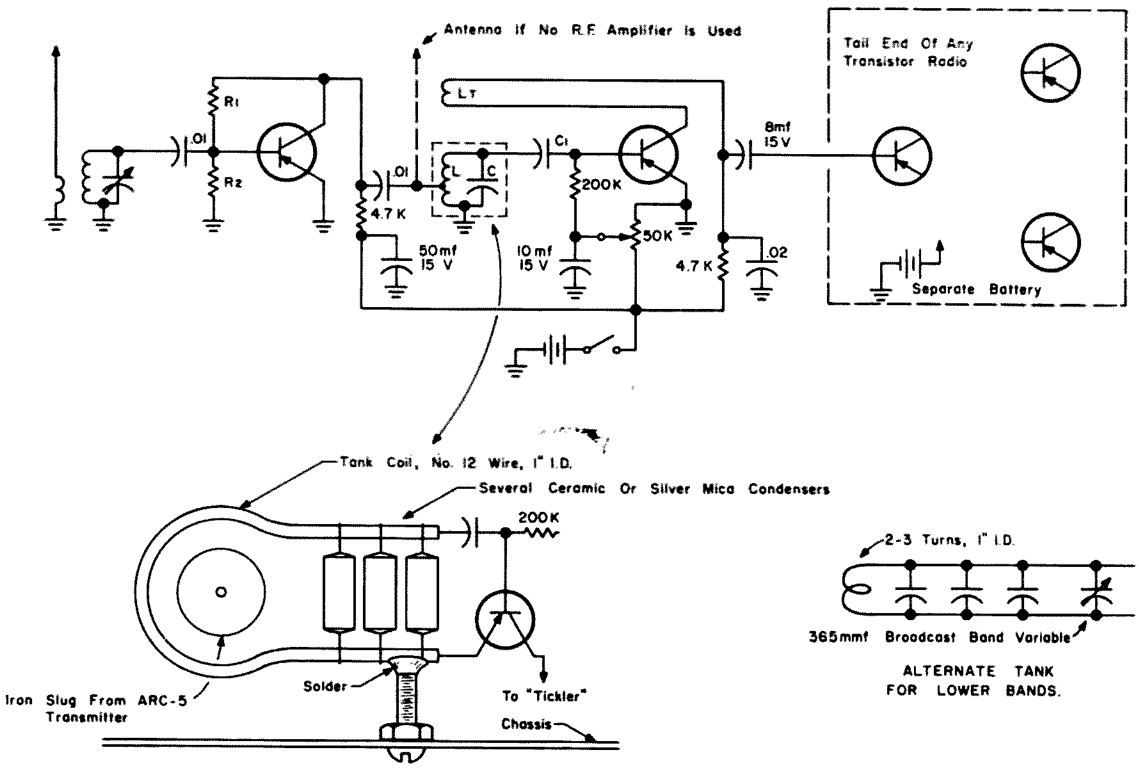

FIGURE I

		80M	40M	20M	15M	6M
L		3T	2T	1T	1T	1T
L_T **		6T				
To resonate at this band						
C	mmfd *	8000	6000	1000	300	100
C_1	mmfd	100	100	50	30	30

* **C—must have several condeners (about equal size) in parallel to decrease their inductance.**
** **L_T—same ø as L but #24 wire. R_1 & R_2 to provide bias for rf amp. transistor you are using.**

making your regeneration smooth and stable over a large portion of the band, or *is made use of* as a fine tuning vernier (useful in SSB especially).

A simple receiver that will outperform a number of Superhets (on a single band; all attempts to produce satisfactory bandswitching failed thus far) could look like one on Fig. 1.

With proper transistors it will operate equally well on 2 meters as on a broadcast band. There is nothing really new about its circuit, the only unorthodox part is its high "C" tank; it seems that regenerating transistors "like" this type of input, they quiet down and behave real well, while with "normal" (tube thinking) components they get temperamental. This high "C" tank, plus a small value of base coupling condenser tend to eliminate the harmful effect of changing interelectrode capacitances produced by varying dc (and possibly rf) voltages between transistor elements.

2N169A transistors (6v-9v) were used on lower bands (40 & 80) and a nameless cheap Philco PNP (72c) that is supposed to work to 100 mc was used on higher bands. It worked best with 1½v up to 50 mc; it was necessary to double this voltage to get higher. Not all of them will work good above 10 meters.

. . . K6B1J

Getting Publicity

Fred Bonavita W4WUQ/4
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Richmond 22, Virginia

"Give'em all the facts in one neat package, and ninety-nine times out of ten they will see the light of day."

That's what a newspaper reporter (who later became my first city editor) told me about ten years ago. While his percentages may be a little off, his advice was correct. And this advice is the answer I gave another ham recently when he came into our City Room to find out why a press release he had sent us had not been used.

The press release (handout) had been received alright, and it wound up on my desk to re-write. It came with an editor's comment: "Here, you deal with this if you have time. You know what they're talking about. I can't make heads or tails of it."

This, unfortunately, is a situation frequently confronting newspapers; it is not limited to amateur radio groups. An inadequate news handout is not an uncommon item, especially in a newspaper office where scores of such items appear daily.

But what of the handout in question? Why did it fail to see the light of day in print? And what can be done to bolster newspaper, radio and television coverage of group activities?

Taking a quick look at my friend's handout, it is easy to see just where and how it fell shore. Witness:

"A nationally known VHF authority will address the Blank Radio Club Wednesday at 8 p.m. He is W4XXX, and he will speak on the problems of bouncing Two-Meter signals off Echo One satellite. The meeting will be held at the firehouse and is open to the public."

End of handout. End of information. End of chances to get publicity. What, asked my friend, was wrong with the way it was written?

It simply did not contain enough information from which to write a story, I said. And, above all, it contained no names of persons to call to verify the information or from whom to obtain the missing parts. Analyze the handout.

Questions which come immediately to mind are:

(1) Which Wednesday night? The use of a specific day of the month would have eliminated any question here. Since the handout was received on a Monday, was the meeting the following Wednesday or a week away?

(2) Does W4XXX have a name, or is he just a call? Where does he live? (My Call Book was at home and of no immediate help). And what makes him a "nationally known VHF authority?"

The problem of explaining the radio terms to the reader was mine. And it can be said that with a little extra digging I could have come up with some of the missing information. However, the press of routine assignments and duties kept me from devoting additional time to chasing down answers to the handout. There are few newspapers these days that are willing to tie up a reporter in plugging holes in handouts.

My friend left with a better understanding of what a newspaper requires in the way of

information before publishing a story, even one that will run only two paragraphs.

Of course, it is impossible to say that every newspaper will follow an "A-B-C-D" pattern in its requirements; these requirements vary just as newspapers themselves vary. But there are certain basics common to all.

These are the old "Who, What, When, Where, How and Why;" but it's necessary also to give complete details of each. For instance, the "Who" may be known in ham circles as Doc Smith, but unless Mr. Smith's given name is Doc, he is identified better as J. T. Smith or better still as Dr. J.T. Smith, if he happens to be a doctor. Some newspapers will go so far as to identify him as J.T. "Doc" Smith, but their number, fortunately, is on the decrease.

The "Why" angle of news is becoming an increasingly important item, and if the "Why" is unusual, it may be the vehicle needed on which to "hang" a story.

Include the names, addresses and telephone numbers of all persons who may be contacted for verification and amplification of a handout. Some newspapers refuse to print even a one-paragraph item unless every detail can be verified, and they are right in doing this. This, by the way, is a major reason why my friend's handout failed to make print.

Tell the newspaper of any picture possibilities. Some editors react immediately when told of an event with, "Any pictures in it?"

Most newspapers rely on out-of-town correspondents to furnish news of their localities not offered by the wire services. As an aid to these correspondents, these papers usually prepare a style manual or writing guide spelling out how to prepare news copy. A copy of this guide or manual is an invaluable addition to any club's publicity department.

A club publicity director should drop into his local newspaper office(s) and become acquainted with the editors, reporters and photographers. He should let it be known also where he can be reached should the newspaper have a question. He should find out what they expect of him and what he may expect from them in return.

Remember, the key to good publicity is to have a worthwhile news story and then present all the facts in a tight, information-filled package that "touchs all the bases." And do it while the news is fresh.

"Give'em all the facts in one neat package, and ninety-nine times out of ten they will see the light of day," the man said, and he meant it.

. . . W4WUQ/4

More Comments on RM-499

The following were written on some of the IoAR RM-499 ballots

In Favor of Proposal

I think that you have gone overboard in opposing RM-499. I believe editorials in two issues of 73 would have been reasonable and sufficient, but by continuing you are acting like a baby whose toy has been taken away. RM-499 if passed will be very beneficial, and the equipment that may have to be set aside for a few months will not be destroyed by being set aside. * We should never have left incentive licensing in the first place. Let's get the appliance operators out of amateur radio. * Would prefer to see all conditional and general class "blanketed in" just as class B's were "blanketed in" with general class some 10 or 11 years ago. * Time to separate the men from the boys. * I am getting terribly tired of the yapping in your magazine. * Everything our country has accomplished was because of incentives. Only communism tried to keep everyone at one level. I say let the dummies get out of amateur radio. * I hope your poll comes back 100% in favor of incentive licensing! I think you're fighting a loosing battle. * The guys who now are yelling the loudest most likely never bothered to vote for their directors to ARRL. * I think this is what should have been done a long time ago, those with the higher grade of license should enjoy the special privileges for their extra effort. * I feel the regulations as proposed are sound. * Wayne, your greed to build up circulation by buttering up the disgruntled would be CB'ers is seconded only by the mad mouthings from the west coast. I am with you 100% if you will fight for a better informed amateur. Surely you are not blind to the danger here at home to our 10, 6 and 2 meter bands. Let's all pull together to save amateur radio. Incentive licensing is too little and too late. But it is a start toward cleaning up the mess the greedy few have made of the art. * It's about time everyone wasn't allowed to run wild. * You must be

crazy. * I am only a general class licensee but I am certainly not too lazy to get a class A. *

Opposed to Proposal

Thanks for bringing the other side of the issue into the open. * I oppose the proposal even though it will not directly effect me, I also object to the ARRL's arbitrary handling of this matter. * Something is needed, but I deplore the ARRL's methods. * ARRL's action on this issue has prevented me from joining the League. I see no need for "incentive licensing." * This is the way proposals should be made SIC EM Wake up the ARRL. * I hold an advance class license and have voted against this proposal because a good many of our conditionals are women and another exam would be an extreme hardship. * If the ARRL continues its present course I don't know how much longer I will be a member: * This is the proposal of men afraid of competition — no matter how little. * They are out of their cotton picking minds! * Not only am I opposed to this proposal itself, but I think that if the ARRL gets its way it will start trying to legislate other items such as pushing Techs off 6 & 2 etc. * Member of ARRL from 1957 to January 1964. Did **NOT** renew! I am opposed to the proposal as it now stands. I am in favor of some type of incentive licensing. Example: New frequencies for extra class license. * This proposal sounds like a destruction of the amateur bands. They are not for us, but **AGAINST** us. * Best of luck. Hope we win! My gripe is a poll such as this type was not taken. * I wouldn't have minded getting on the train, but I didn't like the railroading. * I am in favor of extra privileges for those with licenses above general and conditional. * Leave well enough alone; the air belongs to everyone, not a select few who are engineers. * By acting as an absolute oligarchy the ARRL membership is no longer represented. * There should be only one class of ham license, "amateur class" with all amateur privileges. * Opposed vehemently! * I want to be represented rather than told what to do. * Too much evidence is available to indicate that the ARRL is not acting in the best interests of ham radio. * I do not believe this proposal will accomplish anything, except much expense on the part of the FCC. * I don't think that a few individuals have the right to propose such a plan without first taking a consensus of opinion. * ARRL phooey!! * I am glad to get a chance to vote on this issue though Ioar. * I am dropping my ARRL membership when it expires. * Hurray for Wayne Green * Nuts to the ARRL headquarters staff. * I am against railroading any matter, whether it's ham radio or otherwise. * I quit the ARRL. * Will cause hardship for too many. * Idea has merit, if it covered all bands, but the method is rotten. * I would have liked at least a chance to voice my opinion. * It's about time we had a "two party" system in ham radio. * It's about time someone did something about the ARRL. * Keep amateur radio a hobby. * Back you to the hilt. * I feel that all amateurs should attempt to qualify themselves technically without limitations and laws. * I'm again it. * glad to find someone who will fight for our rights. * I am in favor of improved operation but I am opposed to the assumption of any autocratic group setting themselves up as Big Brothers. * Let Wayne do it his way, which is in the interest of majority of hams. * I am in favor of incentive but not one that takes away privileges from present licensees. * Prefer lower power limits 250 to 500 watts. * More frequency can be acquired if asked for. Wrong approach being used. * I believe incentive means to give a person something which he does not have, but has a desire for, by offering him a means to achieve the goal. I agree in the general idea of improving the amateur operations, but certainly the manner in which it is proposed and the method used by ARRL makes me very unhappy. * Let's cut the power down to 200 watts everybody on all bands. * ARRL has rocks in their head; most amateurs are amateurs not electrical engineers. * I am disappointed in the ARRL; even unions give their members a chance to vote. * We need some changes but not the one proposal submitted. * The highways are crowded and they are not taking any cars off the highways. They're building new roads. * I am not in favor of ARRL proposal at all. *

Harvey Brain VQ9HB

Aldabra

Being a voyage to Aldabra by the 36 foot Gaff Cutter Yacht "LUA LUA," crewed by the owner Mr. Bindshedler, by Mr. Gus Browning W4BPD, and by Mr. Harvey Brain VQ9HB.

On the 22nd of April, 1962, the peace of a meaningless Mahe day was abruptly shattered, for Ben and myself, by the arrival of Mr. Gus Browning, a well known American radio ham. He was going to make a DXpedition with us to the Aldabras. 'With us' needs qualifying. Ben, the owner of the yacht, is no radio ham. In fact, I am fairly certain that he now regards all hams as being certifiable!

Gus did not loiter. In fact everything Gus does is 'at the double'. So that the time it took him from the Customs to the Short Pier wasn't worth considering. "Hey: is that the little yacht down there?" "Looks OK to me." "Hey: Let's get aboard." "Hey: just hand me down that transmitter there . . . . . .this cabin table, right here; why that will take all the gear." "Guess we can all eat our food on the floor—or somewhere." Ben cast me a somewhat agitated glance. It did just cross my mind that this trip might not be quite so restful after all.

We left by the Cerf Channel late on Wednesday afternoon, the 25th of April. We ghosted down the East coast of Mahe to a light North Westerly breeze, weathering the Southern end of the Island just after dark. From there we set a course for Alphonse Island 210 miles away, and to the South of the Amirante Islands. The breeze became fickle. The sea was calm. So Gus was happy. Not only was Gus happy, but Gus was getting organized.

At Mahe Gus bolted down on the "Lua Lua's" small stern deck, a 115 volt ac generator. There it was best calculated to snarl up the mainsheet. Climbing the shrouds, all the world like some convolnlus from the tropical forest, was Gus's 'smack up to date' ground plane antenna. There it was best calculated to interfere with the sails; our main means of propulsion. Hi. Still this was a DXpedition! Something had to be sacrificed before the shrine of Radio.

The generator was now spouting flames and the noise was quite infernal. Ben's watch below, but Ben was not to sleep. Gus himself despises sleep. Gus thinks that time so wasted is quite lost to ham radio, and irrecoverable of course. Gus down in the cabin was seated before his rig, the meters and the dial lights yellow in the darkness before him. "VQ4GT this is VQ9A Maritime Mobile. Good evening Leny. Glad to meet you Leny. All OK here and we're about 12 miles West of the South of Mahe. Old Man Leny; you and George get us a weather report every evening at this time, *please*. Tell us when there's one of them hurricanes about. Hi. Be looking for you every day this time—1700 GMT. Good night Leny and 73's. VQ4GT from VQ9A Maritime Mobile on the Indian Ocean. Goodbye Leny. . . . . . Now all you boys calling there; come in now, *please*, but not all at once. . . . . ."

That diabolical invention nesting on our stern—the 115 volt ac generator—continues to shatter the peace of the night. But from my place at the tiller I can just hear disembodied voices from the loudspeaker in the cabin below. Fantastic that some chap in London can follow our wanderings; can actually speak to us day by day. Likely he is wistfully wishing himself here with us on the Indian Ocean. On the Indian Ocean ploughing across blue sunlit seas. Away from it all: away from the fog and the grime of London's City.

Eager voices. "Hallo Gus old Man. Very glad to meet you Gus. Please Old Man Gus; don't forget to be looking for me from Aldabra. Cheerio Gus and 73. Sure was good to meet you Gus . . . . . ."

At 2200 hours ship's time Gus pulls the big switch. The generator peters out into silence. It has been decided that the enemy must be 'throttled' at this hour each night. Somebody has to sleep some of the time. Silence now and the stars steady above me. Silence and the dark mysterious sea around me. Silence but for the swish-swish and the gurgle of water as the 'Lua' swings along at three knots or so. I do not dwell on these things for long but only on my bunk below, where later the black cat—now asleep on the bench by my side—will follow me no doubt, when my watch on deck is over.

1000 hours ship's time the next day; April 26th. The sea is not so calm. Not so calm at all. Ahead, over the undulating swells, drab green tops of palms seem to float on the misty horizon. I, for one, am happy to see this island. I wonder if Gus would be happy too? "Hi Gus—how about all that washing up you haven't done?" "I guess I can't do that now at all; I'm just looking for my seasick pills." "Come on Gus, they say there's no better cure for sea sickness than to be occupied." "I sure am occupied; I'm still looking for them seasick pills."

Saturday, April 28th. 1700 hours GMT. Weather fine and clear. South Easterly breeze and a calm sea. Peace and quietness should be with us, but that generator is running again. "VQ9A Maritime Mobile from VQ4AQ in Nairobi. Good evening Gus. Evening Ben. Evening Harvey. George speaking. Gus: I have weather report. 300 miles South of Mahe, squally Southerly winds; 20 to 25 knots. Sea moderate. Best I can do. That's all for to-night so over to you Gus, and let's hear your voice Harvey; haven't heard it for a long time." ". . . .VQ4AQ, Nairobi from VQ9A Maritime Mobile. All OK George. Your signal is 5 and 9: fine business. Weather still OK here. Hey: we've just been to an island and I've seen all about how they make copra. When we was goin' away George, why they gave us a loaf of bread an' two roast chickens. That black cat, he spent all last night, George, just sitting under that roast chicken locker. He never even moved. We're just looking around on the chart now to see if there's any more of them islands about here. Hi."

Early the next morning the two amateur navigators had found yet another island. "Gus: come up and see Alphonse." "How do you guys know that's Alphonse. "Might be some other island." "All look the same to me." "Well Gus: we usually call in and ask the Administrator."

Gus W4BPD and friends.

A rising Southerly wind accompanied by a considerable swell made the usual anchorage untenable and so we had no option but to enter the lagoon. This necessitates following the breakers round to the South, and then by way of 'Le Canal de la Mort,' (The Death Channel)—blood chilling appellation—one comes to the pass. There, with the Red Ensign at the masthead, we awaited a pilot. No boat, however, was seen coming our way, and the sky was looking black and squally to wind'ard. Ben, therefore, decided to do his own pilotage. And so we hove up the centerboard—thereby reducing the vessels draught to something less than three feet—started the engine and entered the pass.

The passage through the reef can be dangerous, especially during bad weather when the sea breaks all around the narrow entrance. To-day, however, the pass was on its best behaviour. The sea broke sporadically as we entered. Suddenly the water beneath our keel became as clear as crystal and one could see every little detail of the bottom. The corals were splotched with marvelous colors: mauves; olive green; chromes; rust red. Here and there a stain of brown—the occasional niggerhead—but these were easily avoided. It all looked horribly shallow, though I do not suppose that anywhere in the channel was there less than 12 feet of water. Clear of the shallow rim of the reef the water deepened and became the turbid green of decaying vegetable matter held in suspense in still water.

Before us now, the island with its fringing golden beach; its crown of lustrous palms. Then came the administrator, approaching in a white gig. We were given a very cordial welcome.

Monday, 30th. April. The generator is at it again, for it is 1700 hours GMT. "VQ9A Maritime Mobile this VQ4GT. Good evening Gus. I have your weather report. 'Unsettled weather 450 miles South of Mahe. Wind 20 to 25 knots; squally; backing to SE or ESE. Sea moderate. . . . .' "VQ4GT is VQ9A Maritime Mobile. All OK Leny. You're 5 and 8 here out in the Indian Ocean with Alphonse Island 6 miles astern. No wind at all here Leny and we're under engine. Tell George we've just been to another island. That black cat, he's sitting underneath the roast chicken locker again. Guess we must look around: see if there's any more of these islands about here. Hi. Good night Leny. Tell the boys now only 360 miles to Aldabra. 73's. . . . ."

"All you boys calling me right now. I'm pulling the big switch. VQ9A Maritime Mobile don't count as no new country. Saving all the gas for when we arrive at Aldabra. . . . . ."

Tuesday evening, the first of May. VQ4GT . . . .450 miles South of Mahe . . .25 knots. . . . squally. . . . ! ! ! A force 5 wind now blows, (16 knots). Ben has pulled down the first reef in the mainsail. He has set No. 1 foresail. Our sizzling wake speaks of six knots.

Darkness and a drab horizon. Patches of clear sky brilliant with trembling stars playing hide-and-seek amongst the drifting trade wind clouds. But I cannot abandon myself entirely to the wonders of the night sky for I have a course to steer. Three parallel phosphorescent lines shimmer from the compass dial before me. It is my business to keep them parallel. I am conscious that the wind is cool on my shoulder and on my neck. I sense, though unseen in the darkness, the black cat is close by my side. Those faint phosphorescent shimmering lines. . . . . . I must keep them parallel. They mesmerise with their dancing ghostly light. One hour: two hours: three hours: more than half of my watch has passed. I will certainly fall asleep. I bestir myself; disturb the black cat; lash the helm; get up; study the horizon all around. Nothing but the dim forms of the silently working sails. Nothing but the swssh—swssh—sss as the cloven water laps astern, frothing and foaming into our luminous wake.

Thursday May 3rd. 1700 hours GMT. The generator almost drowns the voice of the wind. "VQ4GT from VQ9A Maritime Mobile. OK Leny; say let *me* give *you* our weather report. Wind ESE force 7 to 8, (30 to 37 knots). Sea high and steep. with breaking crests. Harvey says we are now running under twin foresails on a WNW course, and 24 fathoms of warp streaming astern to slow us down and to keep us steady. He says Cosmoledo is about 36 miles on a bearing 274 true—as far as he knows. He says he hopes to miss it! This black cat, Leny, down here right by my side, he don't see no

fun in all this; he sees no fun at all in all this rollin' and rockin' around."

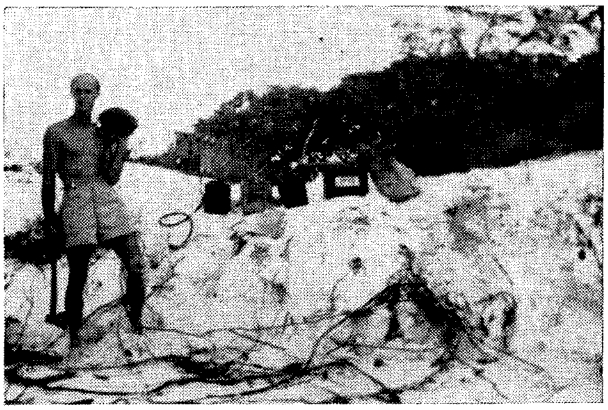
0200 hours the next day—Friday, May 4th. Ben and I are both on deck. The sea is very confused, pyramiding and with breaking crests. The wind blows in great gusts from a clear sky. Almost one would say that we were in shoal water. The cries of seabirds are heard all around. But the moon is up and 7 x 50 binoculars reveal—nothing.

345 hours. Ben sets trisail and storm jib, and hands the twin foresails. We change course to 240 degrees magnetic to close the land. Strong currents run here. Our position is anybody's guess.

0800 hours. In spite of the high sea, the appalling motion, and the hazy horizon, Ben managed to get a sight. Worked out it gave a position line 30 miles farther to the West than our deduced reckoning. So we might be quite close to Aldabra! But Ben, unused to this area of fierce currents, was unconvinced and inclined to doubt his sight. 0930 hours; I obtained another sight and this put us even nearer to Aldabra than the previous one. In fact, if it could be relied upon we should soon be seeing land.

Time went by and nothing solid was visible across the waste of confused rough water; the squalls of rain; the lowering clouds. "Ben, there's no chance, I suppose, that we might have mistaken the date and so looked up in the wrong table?" Ben was sure of the day and date—Friday, May 4th. Then he wasn't so sure. "Could it be. . . .?" Do you think, Ben. .?" Well; could it be Saturday, May 5th. for instance?"

"Gus; start up the stinkpot." "Ask some fellow what day it is." "They'll think we're all crazy guys." "CQ: CQ: CQ. . . .CQ. 20 meter phone—from VQ9A Maritime Mobile. Will somebody come in, *please*?. . . . .OK Old Man, this VQ9A Maritime Mobile from somewhere in the Indian Ocean." "Ben; there's a guy here



Harvey VQ9HB

VQ9HB

in Durban. He says its May 4th all day in South Africa. Wants to know if he can send two more guys with two brand new sextants? Hi."

By 1700 hours ship's time we were under the lee of the North Eastern corner of Aldabra, and only too thankful for the certainty of a quiet night at last, away from the swell. The settlement was still some 18 miles to the Westward but we knew that it would imprudent to approach this indifferent anchorage after dark. We therefore eventually hove-to to the Eastward of the Main Pass and awaited the break of day.

On our arrival at the settlement the next Administrator arrived with the big pirogue and Gus, in command of all his baggage, was ferried ashore like some Eastern Potenate—even though he lacked the Royal Umbrella. Then Prince Charming and his shining modern equipment was installed in the Guest House ashore, while we, with the 20 years old converted ex. military transmitter, slunk off in the 'Lua Lua' into the lagoon, where we hid ourselves, like Cinderella, in the remotest corner that we could find.

The lagoon is very shallow and dries out over a large area at low water. Ben beached the 'Lua' on hard, clean sand, and legged her up, so that during the period of the spring tides he could clean and paint the bottom. Then when the receding tide left the vessel high and dry we humped all the radio equipment ashore and installed a bell tent on a nearby spit of land. This situation was not ideal for it was surrounded by mosquito-ridden mangrove swamps and moreover there was scanty protection from the prevailing wind. However, this area contained a number of casuarina trees of a suitable height for the installation of the antennas.

By 1400 hours on May 5th the work ashore was completed. The tent was up; two antennas installed; the wind motor errected; a table, supported on a number of 4 gallon petrol tins, had been improvised for the gear. So VQ9HBA was now ready to go on the air.

VQ9HBA was a very modest affair. The transmitter, a wartime Collins TCS-12, drawing power from two dynomotors which, in turn, depended upon 12 volt heavy duty storage batteries. It is unlikely that the transmitter output exceeded 16 watts or so. The receiver, an old Eddystone 750, was efficient but made heavy demands on battery current. For charging the batteries we used Ben's 300 watt, 12 volt, petrol generator, for which we had brought 16 gallons of fuel, (we used just 7 gallons for about 45 hours of operating). But as a standby we had the portable wind motor, so that a major breakdown of the petrol generator would not have put me off the air. We were about a mile from Gus and at that distance there was no mutual interference.

At 1400 hours GMT. I started operations, using a vertical end fed half wave antenna. "CQ: CQ: CQ. .from. .VQ9HBA on Aldrabra. CQ: CQ: CQ. . . . . ." No response. Nevertheless plenty of stations could be heard between 14 megacycles and 14.100 megacycles. I confined my attention to 14.085 megacycles. No contact. I checked the output with the neon lamp and that seemed all OK. So I changed over from the half wave vertical antenna to the full wave horizontal. The latter had been installed in a SE/NW direction which was not ideal for working the United States, however, the trees were orientated in that direction and so it was 'Hobsons Choice'. "CQ: CQ: CQ. . .from. . .VQ9HBA on Aldabra." Then at 1415 hours GMT ZS5KU in Durban replied, giving me RST 599. He had the distinction,—if you like—of being my first contact at Aldabra. He was elated. He had a rare new country. I was elated. He was my first contact from Aldabra. After this the stations started to roll in but I was delighted that No. 3 was VQ4GT, my old friend, my very first ever radio contact—Leny. But the W Boys, where were they? I heard not one.

Gus, in the meanwhile was in trouble. He had forced and broken an aluminium needle valve of the ac plant carburettor, and the broken point had jammed in the main jet. Can't think why aluminium was used for the valve. It surely should have been in brass. Anyhow, we had the good fortune to extract the broken piece by heating the end of the main jet and then plunging it into cold water. But now Gus has more trouble. A crushed plastic carburettor float valve. Why must they make *this* in plastic? Usual modern stuff. Pretty, but

not durable. So now we'll have to fiddle this up somehow or Gus is off the air for keeps. Prefer my old solid transmitter and batteries; plus windmotor; plus charger. Ancient and despised but infinitely reliable!

Aldabra is a raised atoll consisting of four principle islands. Their structure is of coral, or coral rock, the seaward face of which forms abrupt overhanging cliffs from 12 to 15 feet high. The islands are largely covered by almost inpenetrable pemphis jungle and the shores of the lagoon are fringed by extensive mangrove forests. All along the foot of the dead coral seaface one finds little white sandy bays. And each afternoon, in the warm pale green laughing waters of one of these, I used to bathe. On a jagged pinnacle of rock nearby, a pure white egret, a bird without fear of man, would cock one beady eye on me—in curiosity. He would think, no doubt, as I sported in the playful swells, "this seems a new and interesting speciman; wonder what he thinks he's up to?" Each day he was there *awaiting me*. I like to think it was always the same bird.

The walk back along the dunes twists and turns amidst the pemphis shrub. And every clearing offers glimpses of the lagoon and pass, of beauty almost beyond belief. The swift waters of the pass, steely blue and sparkling in the sunlight. The lagoon, a patchwork of color where deeps and shallows give rise to blues and greens and turquoise, and all a-glitter under the deep blue sky. While here and there, small barren islets; jagged fragments of this dying atoll; litter the lagoon and make one think of worlds long cold and dead. All this can bring great contentment to anyone whose mind can be in harmony with these values.

2230 hours local time. The mosquitos from the swamps are biting my legs in the tent. "CQ: CQ: CQ. . .W: W: W. . .CQ: CQ. . . . ." But the W Boys do not reply. Outside is black night and a rising gale. Inside the tent on the camp bed the black cat sleeps on. He knows how to jump off the boat and on to the sand at low tide. And he has discovered my retreat. "CQ: CQ: CQ. . .W: W: W. . . . ." But the W Boys are mute. At 2217 hours—"VQ9HBA this is UA3CT. Good evening Old Man. My name is Kon and my QTH is Moscow. Your signal is 589. Fine business. I am very glad to meet you. Please do not fail to QSL. Many thanks Harvey for the vy fb QSO and I sure hope to meet you again. Vy 73's. VQ9HBA from UA3CT in Moscow." The gale is increasing in strength and the tent is rocking and flapping. Two German stations come in—DL1QT and DL5DU,—and then, at 2306 hours

one side of the tent blows in and the light goes out. I struggle in the darkness under flogging canvas and manage to find my flashlight and extract the black cat.

Friday May 19th, and two days before leaving the lagoon. We set up a 136 foot long wire antenna orientated in an approximately ESE/WNW direction. The average height of this antenna was about 36 feet.

Quite by chance, I had discovered that the 14 megacycle band opened up for a very brief spell at 0340 GMT—almost precisely. The heavy blanket of static which hindered us during most of our stay at Aldabra, fell away then like a curtain drawn aside. So at 0130 hours GMT the next morning I was already waiting expectantly at my post. I was soon to experience several shocks—of a non electrical nature.

Soon the first light of day filtered through the clouds. I was tuning the band but was unable to find any W's. Only an occasional Russian or Pole broke through the abnormally thick static 'fog'. I did not contact these. I was saving my batteries. Suddenly—Wallop—bang—twang. The transmitter almost leaped ofl the table. Followed other disterbances of a similar nature at close intervals. One might have supposed that the long wire antenna was being subjected to a peculiarly accurate bombardment. So it was. Outside I soon discovered the explanation. A flight of boobies had hit the wire. Now they were all out of formation and milling around at various levels in complete disorder. One giant fowl seemed considerably annoyed. Having shot up into the air after the initial impact he then dive-bombed his invisible enemy. Don't tell me that the booby is a stupid bird. That evening the same flight, returned from their fishing at the same height. As they approached the wire, in line ahead, each bird 'ducked' (if I may use the pun), and passed safely underneath.

Anyhow, when I had finished cursing the B's, I returned to the set in search of some W's. And at 0313 hours GMT Ben placed a very fine breakfast before me. . . . an omelette and a steaming cup of coffee. I picked up my fork at that moment the W's struck. The veil of static had been dramatically rent asunder.—"VQ9HBA. VQ9HBA. . .from. . .W8FGX—VQ9FGX from W9RK—VQ9HBA this is W1FH—VQ9HBA his is. . . . ." "W's this is VQ9HBA on Aldabra. W's move up 10 kc on the band *please*. Sorry Ws. can't talk to everyone at once." VQ9HBA. . .VQ9HBA. . . VQ9HBA from W5PSB—*please*." "W5PSB from VQ9HBA. . .Good morning Old Man. Ur RST 589 in Aldabra. Fine business. Name is Harvey. . . ." " VQ9HBA from W5PSB. . . Many thanks Harvey. Psd. to meet you. Name here is Pat and QTH in Texas. UR putting in a fine signal here Harvey—5 7 & 9. Will not hold U. Many stations calling U. 73s. . . ."

At 0432 GMT the static closed in solid again, shutting out all the W's completely. But by then I had a long list of W's worked before me. My untouched breakfast lay stone cold on the table.

After this I took a walk to the settlement. I thought I would boast of my achievement to Gus. But on arrival at the Guest House I found its inmate stretched out on his bunk asleep. His mouth sagging open. Too tired to snore. Exhausted. No doubt, all night, he had been over chasing W's. Three small Aldabra kid goats romped around the polished floor. But Gus slept on. Over there the table with the sets—now abandoned. Its white cloth powered grey with the ash of countless cigarettes. A litter of wind blown paper on the floor.

Monday 21st. of May. A light Southerly breeze. And at 0900 hours ship's time we shook hands with the Administrator. We set the full mainsail and the genoa. We proceeded Eastwards, and towards Mahe, along the northern shore of Aldabra.

Under the lee of the land the sea was calm and we made good progress until some distance the other side of the main pass. Here the wind headed us and forced us on an off shore course. But by mid-day the sea was still reasonable enough to allow us to take our lunch in comfort. It was the last time that Gus was to appear at lunch—or any other meal—for many days to come. In so far as Gus was concerned, the voyage from this point onwards was completely peaceful, for he went into almost total hibernation, being even incapable of pulling the cord of our little 'Frankenstein Monster'— 115 volt ac generator.

1400 hours and change of watch. Log 22.5 miles. Wind SSE force 4. Weather fine but sky hazy. Course 075 degrees true which—allowing for current and leeway—should just have allowed us to fetch Alphonse Island, now 390 miles away.

My watch below. I decided to turn in and to snatch some sleep while the going was good. In the forecastle the motion was considerable. From my bunk, on the weather side, one could hear the resounding blows of the seas, just by one's ear, against the steel plates of the hull. As all the ports were closed the atmosphere soon became oppresive, and moreover, the air was charged with the nauseating fumes of benzine coming from, I believe, an imperfectly sealed tin stowed just below my bunk. So I

was soon in a similar state to Gus, and left that forecastle hastily, never there to return for the rest of the voyage.

1900 hours. Log 47 miles. The breeze had freshened considerably so Ben double reefed the mainsail and shifted foresails, making all snug for the night. It was well that he did so for later during my watch it breezed up with heavy squalls from the SSE, and the vessel—even under that canvas—was just about as much as I could manage. And one is always reluctant to call out the watch below unless things seem to be getting out of hand. The crew of a small vessel on 'the great waters' need all the sleep that they can get, for they never know when wild weather may demand many hours of vigil.

We had already decided to work 4 hour watches during the hours of darkness, and 5 hour watches during daylight. So at 2300 hours I handed over to Ben. By then the wind had increased to about force 5 or 6 and was still from the SSE. The vessel was sailing very fast and the log read 69 miles.

My watch below, but as I was unable to sleep in the forecastle, I had to improvise a bunk on the saloon floor. A lot of water was sloshing about there. And every now and then heavy spray would sweep the coachroof above and then, water dripping from the skylight, would find its way to Gus or to me. At about 0200 hours, Tuesday May 22nd., the vessel was thrown violently almost on to her beam ends. Torrents of water seemed to sweep over the cabin top. There was a series of crashes and thuds, as an avalanche of cushions and heavy objects sailed from the weather bunk and past my head. Switching on the light revealed a state of dreadful disorder. Amidst a litter of sodden books and wet cushions were seen Gus's Transmitter and Receiver, both upside down in the bilge water. As though this were not enough, Gus's brand new camera in its smart yellow leather case floated amidst the debris. It is hardly an exageration to say, that we passed a most miserable watch below and that we lost a lot of sleep.

0300 hours. Unfortunately my watch again on deck. The weather had obviously deteriorated and so Ben pulled down the third reef and took in the small jib. The vessel at once became easiér on the helm but she was still sailing fast. A very big swell was rolling in from the SE. The wind was gusty and at times force 6 or more. Low scud raced across the sky, and shutting out the moon and the stars, cast grim shadows across the rough sea. To the South'ard, against a background of storm cloud, stood a perfect lunar rainbow. And this was not a good sign.

0700 hours. Log 105 miles. Speed about 5 knots. A high sea and a strong wind still from the SSE. A typical, sullen, overcast, monsoon sky of the kind which makes all observations most difficult. I was very tired but held on while Ben prepared our breakfast. How does Ben manage to keep his pots and pans on that reeling stove below, and at the same time maintain his balance? All this would try even the most skillful juggler.

During this breakfast, I noticed for the

first time, a little black bird with a white breast gliding around in the valleys between the wave crests. A storm petrel, though not the true storm petrel of the Atlantic. These birds like to follow ships and are believed by seamen to be the harbingers of bad weather. They are also known as 'Mother Carey's Chickens' though I know not why. I recalled then that a local 'sea cook' on seeing one of these used to work himself up into quite a frenzy. "Mauvais oiseau: tue-lee: shoot the B'. Petrel is a diminuative of 'Peter', (St. Peter), and this genus was given the name because of the habit of fluttering their feet almost on the surface of the water, and thus giving the impression of 'walking on water'. (Matthew XIV —29).

Dawn, Wednesday, May 23rd. The vessel was under storm jib and trisail. The sea was as high and dangerous as I have ever seen from the deck of such a small boat. The force of the wind I estimated at 8, (34 to 40 knots). An incredable confusion of monstrously steep seas with foaming, toppling, crests advancing upon us inexorably, and then, almost miraculously it seemed, passing harmlessly under the hull to reappear to leeward with a roar of riven water, just near my elbow where it rested on the cockpit combing. Brave little ship behaving magnificently! These seas were running from several directions. Occasionally two huge crests would charge each other from opposite points of the compass, and then crash down in a welter of broken water, making a noise like a ton of falling masonry. Now and again the top of a crest would smash down on the vessel's coachroof, drenching the helmsman in sheets of flying spindrift, and forcing its way even under the battened-down skylight. On these occasions muffled curses were audible from below as jets of water spouted from the skylight frame and on to Gus's bunk.

"Gus: any water down there?" "Hey: you don't have to tell me." "One of them lands right on my bunk about once every half hour." "Say: you could time your watch by 'em." "Hey: when I get on with them W Boys next time, I'll tell them W Boys if they want to make another DXpedition to the Aldabras they can have all them islands to themselves, so far as I'm concerned." "They won't be finding me there, *No* sir."

The violent motion: the stinging sheets of spray: the sopping cloths: lack of sleep: irregular meals: the menace of the breaking seas: even the dismal whine of the wind in the rigging—all this tends to exhaust a hard tried crew. Not a question of whether a small vessel will, or will not, survive but rather a matter of whether the crew will, or will not, endure.

1530 hours. Still blowing very hard but from the South. Aldabra 210 weary miles astern. We had been set back 25 miles by current. Now brilliant sunshine had broken through the dull sky at last. The sea though still big was more regular. Great seas of deep sapphire blue with almost everywhere the intense white of breaking crests. We hoped that the worst of the storm was over. But the storm petrel was still with us.

The storm petrel did not lie. We had not yet finished with this wild weather. But although it blew hard again that night and early the next morning, we did not encounter again, during the remainder of the voyage, such dangerous seas as we had experienced on the morning of the 23rd of May.

Noon on Saturday 26th of May. Position—Boudeuse Cay in the Southern Amirantes now 65 miles, bearing 52 degrees true. We had been unable to fetch Alphonse; we had been set too far to the West'ard by unfavorable currents. But there was now a marked change in the weather. Gone the blustering, bullying, Southerly gale. But instead, a bright sun smiled down on a blue and sparkling sea. "Hey Gus: how about some eats to-day?"

We're back on the good old corned beef again. Ben fries it up with onions and potatos. Corned beef is the best canned meat of all—say what you like! They've never bettered it. Tinned chicken; tinned ham—you can keep 'em. They're expensive and they all lose their taste with canning. Whereas, as Gus now says, "Good old corned beef; why it tastes of good old corned beef!"

Dawn on Sunday, May 27th, we passed quite close to Etoile Cay and set a course for Poivre Island which we sighted around about 1000 hours. Here we trolled and caught a fine big bonita. Then Ben cut half of this into steaks and fried them. But the chipped potatos —the last of our potatos—evaded him. At the last moment they leapt clear of the stove and landed in the bilge. Never mind; land in sight and Gus is on the feed. So three men and a black cat finished 7 lbs of fish and a packet of Ryevita. Fingers were used for forks.

That evening we anchored in 2 fathoms of calm water under the lee of DesRoches Island. The vessel was unbelievably motionless. We found it hard to sleep. But the next morning we were awake early and set sail for Mahe, where we arived after an uneventful voyage, 32 hours later.

In summing up the return voyage from Aldabra, Gus says, "This sure was no roast chicken trip."

W2NSD/1

IoAR Tour, 1963

Part II

In the January issue of 73 our group of 73 hams, wives and blissfully ignorant tour director, me, sampled the delights of London and Paris.

When we arrived at our hotel in Geneva I was at a distinct disadvantage. All arrangements had been made by mail and since all my letters were in English and all of the hotel letters in French, there was obviously room for mishap. I was not disappointed. No one at the hotel spoke any English and out of our group Virginia and I were the only ones with even a smattering of French.

I could see we were in trouble when I realized that I was going to have to go it alone as interpreter. I soon realized how deep the trouble was when I found that my request for 37 double rooms had been interpreted as a request for quarters for 73 people. They had the room alright. There was one room for six, two for five, six rooms for four, nine rooms for three, two rooms for two and two rooms for one. Yep, it added up to 73 alright. I looked up at the 72 hopeful faces waiting for me to hand out room keys, none of them aware of the problem or that I had just been turned to stone.

Mack W2BIB of Hammarlund, Domenico HVICN of Radio Vatican, and Major Creminizzi of the Italian Air Forces enjoying the show at a Paris night club along with Supreme Court Justice Earl Warren (background). Photo by W2JXH.

Pausing only to take a quick wistful look at the hotel's confirmation of the 37 double rooms I got to work. After considerable mutual frustration I was able to communicate to the hotel keeper that we needed some more rooms. A few phone calls lined them up and eventually I sat back with everyone assigned. We were split up into five neighboring hotels, but we all had rooms.

Geneva under normal conditions doesn't have a lot of hotel space. We managed to arrive in the middle of the disarmament talks and the Space Communications Conference as well as a few lesser known conferences. Geneva was just about full. We were really very fortunate to be able to arrive 73 strong and get rooms at such a time. The Swiss are masters at hotel-keeping and their government tourist office had made the arrangements for me.

Virginia and I walked around the corner, bags in hand, to the hotel where we were staying. We struggled up the winding staircase to the first floor and were quickly shown our room. It looked OK. Then the woman took us out and showed us the toilet. Hmmm. I asked about the bath. "Pas de bain." That's right, the hotel did not have one single bath. . . .not one! It was too late to move on by this time, so we unpacked and went out for some dinner. You can bet that I called the hotel where I usually stay in Geneva and asked if they could possibly make room for an old customer. Thank heaven they did. We moved the next morning.

On our last trip to Switzerland Virginia and I had made it a point to follow the instructions in the book, Europe on $5 a Day, and try the Fondue Bourguignonne. It was so wonderful that we were on the lookout for it again and found it right across the street from our hotel. It was still marvelous. More and more is appearing about this dish in American magazines, the latest being in the January Playboy, page 113.

As we left the restaurant and were walking

Stu Meyer W2GHK of Hammarlund and Bob Waters of Waters Manufacturing at 4U1ITU.

back to the hotel we stopped in a grocery store to buy one of the delicious Swiss sausages. We were just leaving as the store was closing and there, pounding on the entrance door, was one of our group. He was shouting, "Let me in, let me in. Let me in this restaurant so I can get some dinner. What's the matter with you, you don't talk English!" One of the clerks was pointing to the sign on the door showing that they were closed, but our boy was too busy pounding. We stopped him and eventually convinced him that this was a closed grocery, not a restaurant.

The next day we had set aside for shopping. Geneva is one of the best shopping cities in the world. After moving to our new hotel we walked over one of the bridges and spent the rest of the day changing dollars into Swiss Francs and spending them. We bought a cute toy donkey for Tully to ride, a bourguignonne set, all sorts of other knick-knacks and a suitcase to pack them in. We kept bumping into 73 tourers with arms loaded with bundles.

That night we went out for dinner with George Jacobs and Chuck Schauers, who used to write for me in my CQ days, and Bill Orr, who still, I think, writes for me. We had a wonderful reunion, argued a bit over incentive licensing, had another fondue bourguignonne, and perhaps a bit too much Swiss wine.

The International Hamfest started the next morning and most of us were out there bright and early so that we wouldn't miss the technical talks and the chance of operating 4U1ITU. I was surprised to find a lot of old friends and acquaintances there for the hamfest.

Though there was a good turnout from several countries for the hamfest, our 73 people put the Americans in the large majority. We all enjoyed John Huntoon's attempts to ignore this and his careful avoidance of recog-

Domenico HV1CN and unidentified American publisher at the Vatican ham station.

nizing the Institute of Amateur Radio, the sponsor of our trip. The ARRL Executive Committee had already sneaked their petition into the FCC at this time and I'm afraid I twitted him just a bit about it.

That evening a grand banquet was held. It was a fine meal and we all had a good time. The wine flowed like wine and many of our trippers floated back to their hotels afterward. I was enjoying the party until the toastmaster started thanking everyone who was involved with the hamfest individually and had worked his way through everyone from the ARRL, the RSGB, all other countries, clubs, the local amateurs, the International Amateur Radio Club officers, and on down to the table waiters without mentioning me. I felt like two cents and had to leave so no one would see how hurt I was. There's nothing like too much ego, eh?

The next morning we were off to Rome. Caravelle again, via Alitalia this time. No problems this time. We were met at the airport by a bus and a representative of the hotel. The hotel was splendid. We all had dinners near the hotel and got to bed early so we wouldn't be tired the next morning on our visit to the Vatican.

About 8 AM Father Contini caught me in the middle of breakfast and shortly thereafter we were on our way. Through arrangements made by Hammarlund, Father Contini took us on a guided tour of the Vatican, including HV1CN and the Vatican Radio studios, the famous garden, and many other interesting behind-the-scenes places. I didn't tell Father Contini at the time, but our one Catholic couple were the only ones that overslept that morning and they missed the tour. We went to the Vatican from the hotel by trolly. This was an experience too, for the trollies were more crowded than a New York subway at rush hour. Only our Goat Boy managed to get lost. He was looking the wrong way when we all got off. You haven't forgotten GB yet, have you?

Ae we finished the tour the Ecumenical Council was breaking for lunch and there were cardinals and bishops everywhere. Colorful.

Virginia and I took a taxi to the Trevi fountain (three coins in the) and had lunch in a small restaurant facing it. We then walked all over Rome looking for something to buy . . . anything. We tried again all the next day. Virginia began to get desperate. She left no store unpicked over. Nothing. I'm sure I'll never get her to Rome again. We looked over a few ruins, finally figuring out that their system was to use something as long as possible and then designate it an official ruin.

We were all up early again the next morning, for this was our day for an audience with the Pope. Even the Catholics were up. We set out early and arrived at the Vatican about 8:30. Father Contini was right there and showed us where to wait while he made further arrangements. Soon more people began to arrive and by 11:00 we were lost in a wild mass of about 8000 people. Father Contini finally arrived, but there was no way that he could convince the policeman at the gate to open it and let us in. A little while later they did crack the gate and let people trickle in . . . they just about killed each other trying to jam through the gate. Along about 11:30 I made it through. Fortunately Father Contini had taken Virginia and four of our Catholic members of the tour with him when he left us at 8:30 in order to get them a front seat at the audience. When I got through the gate I followed the mob and at length arrived at another gate with several thousand people trying to jam through. Since I had the only pass for our entire group I tried hard to get through there as quickly as possible so I could make whatever arrangements had to be made inside.

I worked my way around the edge of this mob scene and found myself through the gate and walking up about a quarter mile of stairs. Most of the people were going into a large room to my left . . . some were going to the right. I looked in the left hand room and saw about 1000 people in there already, probably half full. I went to the right and discovered a huge basilica. One of the guards asked for my pass and indicated a roped off square where our group was supposed to stand. I then went back to guide the tour the right way. After 15 minutes had passed and no one had shown up I hiked back down the stairs

looking for everyone. Eventually all of the people out in the yard had been admitted and not one of our group was anywhere to be seen. I couldn't understand what had happened. They had all disappeared. I found out later that the crowd had been diverted for a while into another basilica and that almost all of them ended up in there. The Pope went from one room to another, having a short service in each.

After wearily climbing back to our appointed spot I found that three of four of the tour had made that room. Suddenly Father Contini appeared and grabbed my arm, dragging me down the aisle to the front of the basilica, swinging his heavy rosary at the guards trying to stop us. There, in the second row was Virginia and our four Catholics! Everybody shoved over a little and I sat down right on the aisle. The only ones in front of us were the Admiral of the Italian Navy, his wife and mother, and a couple more women all dressed in black. One of the bishops there said that there were about 6000 in our room. Easily.

Along about two and a half hours later there was a rustle and the Pope arrived, carried on a chair by eight enormous Swiss Guards. There were more guards on each side with large battle axes with which they fought off the people trying to touch the Pope. As the Pope's chair was set down right beside me I managed a one finger touch before being crushed between the people pushing behind me and the guards in front. Now I see why they hire seven foot giants to protect the Pope.

The Pope welcomed the various groups present, including the 73 radio amateurs from the United States (muted cheers from those of us that made it). He read a short mesage in several languages and got ready to go. Well, I want to tell you that everyone was ready for him this time. As he leaped to the chair the Swiss guards were almost overpowered by completely insane women, screaming and

W2NSD/1 and XYL at Vatican City.

trying with all their strength to touch him. They climbed over each other, knocked over chairs, benches, just about mashed a half dozen cardinals, and were aware of nothing except "papa" as they clawed their way toward him. If the guards hadn't whisked him out of there at top speed he would have been killed.

It happens every Wednesday.

(W2NSD from page 4)

past director or any of the more influential manufacturers. There has been virtually no way to write about these inside matters down through the years due to the intense devotion given by many amateurs to the ARRL. Now that RM-499 has shocked tens of thousands of ARRL'ers to where they are interested in finding out what happened, it may be possible to view the League with enough detatchment to attempt to cure some of its ills.

With this background you may understand better why I feel it is so important to have the Institute of Amateur Radio start immediately to prepare for the Geneva Conference. It is of immediate importance for us to open an information office in Washington and make sure that by the time of the conference our government is completely convinced that amateur radio is of primary importance and that it must be protected at all costs. We can do it. . . .with your help. Join the Institute.

Suggestions

There will be plenty to discuss at the National Convention in New York City in August, though this may be too soon to have worked out any concrete changes in the constitution and by-laws.

Some suggestions that I might make are: (1) Bring a halt to those secret pre-board directors meetings. This will help to cut out the under-the-table maneuvering. (2) Report all of the board meetings in the minutes published in QST. This may help stop this "unanimous" voting baloney we've been subjected to of late. (3) How about having the membership vote directly for the president and vice-president of the League once every four years. This should not only bring us better officers, but might greatly increase the interest of the average ham in the League. (4) Directors terms should be four years, with one half of them being elected each two years. This would give continuity to the League and would permit directors to wield more influence. (5) Have the board meet two or three times a year instead on just once. This will give the directors a greater say in the running of the League. (6) Require a two-thirds vote of the directors before any specific proposals can be sent to the FCC. This would prevent diasters like RM-499. (7) Complete report of all business transacted at executive committee meetings should be sent to all directors. (8) a referendum of the members be made before any proposals be sent to the FCC recommending the removal of operating privileges from any class of license. (9) Separate the executive branches of the ARRL from QST. This would permit the editor of QST to devote more time to improving the magazine and attending to the other publications and also permit the League General Manager to better manage the many activities of the League. (10) League mem-

(Turn to page 80)

(W2NSD from page 78)

bers should be entitled to know about League expenditures, particularly salaries, retirement payments and business expenses incurred by officers. The full financial report of the League should be published in QST each year. (11) Editorials in QST should be signed so that members know where responsibility lies for statements made. (12) There should be some attempt made to have QST reflect both sides of controversial issues rather than just the League viewpoint. (13) The ARRL should return to the previous system of having a National Convention every year. (14) The League should work together with the Institute of Amateur Radio toward the long range strength of amateur radio.

Cover Ballot

This is being written just a little over a week after the February issue of 73 was delivered to most subscribers, so we have only fragmentary results so far. Since the percentages settled down early in the count and have not varied significantly since, I suspect that we are quite close to the final percentages that will result from the pool.

I underestand from a visitor to League HQ that, "They'll be lucky if they get 500 ballots." Well, we passed 3000 ballots today and they are still pouring in with every mail. I realize that there is bound to be some hysteria from the general Connecticut area and I think we are prepared for it. We are being excruciatingly careful to keep every single ballot that has come in. They will be kept available for a count by anyone who is willing to take the trouble. All of the votes in favor of RM-499 are kept in a small box so they can be located as easily as possible. I figure that there will be very little grumbling over opposed votes. I suggest that some of the fellows who voted for 499 let the ARRL know about their vote so a spot check can be made.

OK, let's see what percentages we have so far. The percentage of ballots opposed to RM-499 has been running between 80-85%, settling down on 83.5%. Naturally you will argue that this is all OK for 73 readers, who might be logically opposed to 499 due to preconditioning from my editorials. One might expect that if we just ran a percentage on ARRL members that answered the ballot we would find a number closer to the 50% claimed by the ARRL. Well, when we look at the ballots sent in by ARRL members and run a percentage on them alone we come up in the same ball park: 81.5% opposed to 499! It is no wonder

that there has been nothing more in the editorials of QST recently. A great many of those 81.5% are pretty furious too. Though we had no place on the ballot to indicate that the voter was quitting the ARRL we found that 18.5% of the ARRL members took the trouble to make a note to this effect.

With such a high percentage indicating that they do not intend to renew their ARRL membership, I wonder just what inroads have been made into the League Total so far. 18.5 percent of 84,000 would be a loss of over 15,000 members.

Geneva: 1965!

Our government agencies are being alerted that the dreaded Geneva Conference is now expected to be held in 1965 instead of the hoped for 1968. This is bad news for the U. S., which managed, many years ago, to come off with an enormous share of the spectrum and has been adroitly staving off the day of reckoning (wreckoning?).

What does this mean to amateur radio? This means that time is running out much faster than we thought. We have just about a year to get our own government behind us and impress upon foreign countries the value of a strong amateur "service." Are we going to just give up or are we going to put up a fight?

We won't have any proof of the danger facing amateur radio until the proposals are submitted by the various countries before the conference. Last time a great many countries proposed cuts in our bands, with some of them being extreme. France wanted to use our ten meter band on a shared basis, provided the amateurs did not create any interference to their services. Picture that one. India thought bands 20 kc wide were really adequate for us. 75 and 80 meters was badly wanted for Central and South American point-to-point business and government communications. International broadcasting wanted more frequencies near our 20 meter band.

To look on the dark side, we could lose 20 meters, at least half of 40 meters, be cut back seriously and reduced in power on 80 meters, and have to share ten meters or maybe even lose part of it. On the bright side, we could hold our own. Realistically I would expect that we might lose 50 kc of 20 meters, 150 kc of 40 meters, and 250 kc of 80 meters, unless we really put up a battle.

The battle is up to you. Is ham radio worth any effort or expense to you? Is the enjoyment worth anything? How about protecting your investment in equipment? The Institute of Amateur Radio has a concrete conservative plan for meeting the coming emergency with positive action. This plan cannot be put into effect without your support. Do you think this is important enough to back?

How can we fight? The ways that seem most practical are 1) Get our own government behind us solidly. Amateur radio provides a wide variety of public services, it is invaluable in time of emergency, and is a training ground for the electronics industry (which has benefitted immeasurably as a result). We have to tell this story to every Senator, Representative, and public official that can possibly affect our future. No such program is now being carried

on. Right now the major source of information about amateur radio is newspaper articles and TVI complaints from constituents. Great, eh?

2) Impress upon foreign governments the value of a strong amateur service to their electronics industry, tourist trade, ability to face emergencies, etc. Amateur radio could be a great thing for newer countries if they only knew about it. No one is telling them. Countries like Burundi, Cameroon, Chad, Cyprus, Dahomey, Gabon, Ghana, Ivory Coast, Kuwait, Malagasy, Mali, Mauritania, Niger, Rwanda, Senegal, and Somali, all of which have a vote equal to ours and are new members of the I.T.U., can put us out of business. These countries need frequencies badly for short wave broadcasting, business radio and military use. If we can't convince them that ham radio is going to be invaluable to them then we'd better have Uncle Sammy behind us completely convinced and holding the biggest stick he's got.

3) There is much to be gained in cleaning up our own house which has gotten pretty messy after all these years of neglect. If you go for my OPU system and crack down on bad signals and bad operating we will be able to face anyone with pride. A little bit of dedication to the technical side of ham radio by everyone and we won't have to worry about do-gooders calling for stiff government regulation.

Points one and two are not being tackled by the ARRL, nor can they do much along these lines without a complete reconstruction of the League due to the limitation of the $5 dues setup. This means that either the Institute of Amateur Radio works on these problems or else no one does. Is ham radio *next year* important enough for you to send in your $10 to the Institute so we can move ahead?

There is only one way that all this can happen. This means that *you* are elected. Send your membership in to the Institute of Amateur Radio right now and put the pressure on members of your local club and fellows you work on the air to join quickly.

This is not a big deal to get people to subscribe to 73 . . . the magazine will stand or fall on its own merits and is not tied in with the work of the Institute except that most of the Institute work is being shoved off on the 73 staffers.

Your $10 to the Institute will bring you one of the nicest membership cards you've ever seen plus a Founding Member Certificate for your shack wall. You'll also get reports on the progress of the Institute.

Take a good look at your ham station . . . is it worth protecting?

Questions

Several fellows have written in asking why the Institute doesn't try to compete with the League. This is simple . . . we need a strong constructive approach to our problems, not one which will tend to further tear apart the fabric of our hobby. I'll admit that it is difficult not to be constantly critical of the League when they devote an editorial that should have explained why they pulled the prize boner of their history to the startling subject: 'The Amateur is Loyal . . . He owes his amateur radio to the American Radio Relay League, and he offers it his unswerving loyalty." Good grief.

I have a question. It is going to be extremely important that we have a darned good man representing us in Washington. Have any of you any suggestions for a ham that could handle this critical job? He's going to have to be someone that knows the answers, will make it his business to get around and see everyone he can and keep his thumb on the pulse of the Capitol. I don't know how much we'll be able to pay yet . . . that depends upon how many amateurs feel their hobby is important enough to invest in it. It does seem to me that this is just a little more important than a building fund for a building which may become a memorial to our departed hobby. Well, anyway, let me know who you think might be able to do a good job for us all.

FCC Action Expected

My files are bulging with copies of letters from the League answering irate members who have written complaining about the submission of RM-499. From the sheer volume and the wide range of names on these letters it would seem that the entire headquarters staff has been trying to keep up with the avalanche of vituperative mail. The answering letters all read about the same and the main point raised is that RM-499 is just one point in the League's ten point program for improving amateur radio. Holy Smokes . . . you mean we have nine more shocks like that coming at us?

I understand that there is a good chance that we may get our cliff-hanging over with this month when the FCC announces a docket of proposed rule making. We'll then have 90 days to file our comments on this docket instead of the usual 60, I believe. Naturally I hope that the FCC will follow their precedents and propose a solution that does not take away operating privileges from anyone.

One of the saddest documents to come from the ARRL in recent days is their rebuttal to the FCC in answer to all of the questions raised about RM-499. After listing several other petitions before the FCC they relinquished even the pretense that the ARRL is trying to provide leadership for us by turning the whole problem (which they had raised) over to the FCC by saying, "Firm guidance and leadership by the Commission at this time is essential."

Institute Tours

It has become increasingly obvious that we just aren't going to have the time to adequately set up arrangements for Institute tours this fall due to the immense amount of work involved in establishing our Washington information office and starting information going to foreign countries.

International friendship is just going to have to wait until next year while we do everything we can to keep ham radio alive so we have something to be friendly about.

New Hampshire Primaries

Normally New Hampshire doesn't make the news very much, but in election year the New Hampshire primaries, being the first in the

country, bring lots of candidates and newsmen. Just in the last few days we've had visits from both Rockefeller and Goldwater and had a chance to compare them. I tried to put aside my distaste over the "Hams for Good Government" debacle wherein New York State amateurs were barraged with literature on Rocky sent by the same fellows who managed the license plate call letters, making the whole works look like a political deal.

Here in Peterborough we were faced with Rockefeller attacking Goldwater rather than explaining his own policies, followed by a no question period in which he shook a few hands and rushed away. I did get my elbow grabbed and was fella'd.

Goldwater made a tremendously better impression on everyone. He gave a short talk and then answered all questions. He refused to say anything against anyone, preferring to acquaint us with his positive views. I had a short talk with him afterwards and he remarked that everywhere he had gone in New Hampshire he had found hams in profusion. He drove the politicians who were trying to keep him on schedule to distraction by talking ham radio with members of our staff. I suspect that one of Barry's most serious problems is going to be his ignoring of politics and speaking out with facts rather than just telling everyone what they want to hear. Our problems would be unbelievably simplified if we had a ham for president.

New York RTTY Dinner

The RTTY gang will meet once again during the IEEE Show. The dinner is scheduled for Monday, March 23, at the Patricia Murphy Restaurant, 260 Madison Avenue, New York City. A la carte cocktails and informal rag chewing commences at 5:30 P.M. with the dinner at 7:00 P.M., followed by some excellent technical discussions. For reservations send a check in the amount of $6.50 each to Elston H. Swanson, W2PEE, Instruments For Industry, Inc., 101 New South Road, Hicksville, New York 11802.

Ten More Rooms

When we moved into our headquarters about two years ago we couldn't even imagine that things would get cramped in a 37 room house. That was before the offset press and its resultant offset press room, the process camera for making the offset negatives brought on the camera room and dark room (the camera is over six feet long), then there is the studio room where we take our 5 x 7 pictures of equipment, the ham shack, the test lab, the metal working shop, the addressing room where our huge addressing machine grumbles away . . . and on and on.

Last spring we added a five room house way up on the high slopes of Mount Monadnock as a summer hamshack, VHF location to end all VHF locations, and experimental lab for Ham-TV, RTTY, wide band FM, etc.

Our latest addition is a ten room house not far from our headquarters building which will give us a bit more elbow room.

. . . Wayne

New Products

Waters Catalog

Bob Waters has quite an assortment of ham products now available. Send for their Amateur Eqquipment Catalog and have full data right at hand on their Dummy Load/Wattmeter, Litle Dipper,tm Universal Hybrid Coupler, Retrofit Kit, Compreamp,tm Coaxil Switches, Illuminated Knobs, Q-Multiplier/Notch Filter, Channelator,tm and Electronic Vernier Tuning. Write Waters, Wayland, Mass. 73 sent you.

New Tube

GE is adding to its Compactron line. The newest, the 6T9, is a combination of voltage amplifier triode (like half of a 12AX7) and a power amplifier pentode (like the 6AQ5, but powerfuller) which will give five watts power output. This one should be fine for small rigs.

More Comments on RM-499

Dear OM:

I am considerably puzzled by a quotation attributed to you in the current issue of 73 Magazine. The reason is that it seems diametrically opposed to the viewpoint you expressed in your letter to me last June. In that letter you offered "a resounding vote of confidence to the Board for its incentive licensing proposal." Do you care to outline just what it is that has changed your mind so completely?

John Huntoon
General Manager, ARRL

Dear Mr. Huntoon:

Yes, sir, I do care to outline the things that have influenced my thinking about the ARRL in recent month; matter of fact, I'll do better than an outline — I'll set it down in detail.

Frankly, I don't think my position has deviated much from the thoughts set down in my letter to you dated 27 June 1963, and paraphrazed on page 85 of September QST; I am still solidly in favor of a return to Incentive Licensing and the Board's overall program as outlined on page 10 of QST for June. Remembering that at the time my letter was written no one outside of League headquarters knew the details of your incentive plan, I then thought your position was reasonable, fairly logical, supported by the majority of amateurs,a nd opposed by the usual vocal minority.

After learning the details of your plan to re-establish restricted voice bands, I found myself in complete disagreement with you, but willing to go along if there were serious reasons justifying the adoption of your plan. My position is still the same today — I think other plans I've heard would make more sense, but, none of this is my main concern. What really hurt was the chaos and bitter, passionate hatred your handling of the incentive issue fostered; the current state of affairs is unnecessary, seriously harmful, and the product of your miscalculations and errors. My letter to Wayne Green, quoted in his February Editorial, applied the adjectives "inept and mislead" to your efforts and I reaffirm that I seriously believe that judgment is correct, applied to the League as a whole; your activities of the past few months, in my opinion, cast serious doubt on the League's ability to effectively represent the Amateur body. Understand clearly, Mr. Huntoon, that my disagreement with your proposal is not the reason for my attitude toward the League; my condemnation of your method of handling this proposal is the reason for my severe criticism.

Take a look at what you've done to swing support behind you. Why was it necessary to spend so much time justifying the word "Incentive"? The precedent in FCC rules is clear; prior incentives were changed for cause, and can be changed again for reciprocal causes; why bring in a lot of nonsense about current trends, without accurately defining what those trends are, and, more to the point, without detailing just how your proposal is supposed to correct those trends. The word incentive is the best one word definition you'll ever find of the difference between the Free and Communist world; it is the reason why the technology of this country has been ahead of all others, and, correspondingly, the reason why we enjoy the highest standard of living in the world. Why try to enlarge on this; Mr. Hoover uses three pages in January QST trying to justify incentive, which needs his efforts not, then refuses to explain the reasoning behind the ARRL plan, which most certainly does need his efforts. He doesn't mention its origin, or why the Board considers it superior to other, more palatable schemes; he pointedly avoids a discussion of the probable effects of the plan, and their application to the solution of the problem at hand. He will not venture into the area which most needs his attention — why? A defense of Incentive Licensing is not the answer critics of the ARRL plan are looking for; can you really expect anything other than the general conclusion that your plan is indefensible?

Even Stalin could never equate incentive and force — what makes you think human nature has changed so radically in ten years? Did you really expect that Amateurs would voluntarily relinquish privileges without being convinced of the need for doing so? To the problem of re-establishing incentive in our licensing structure, why is not the best solution one that recognizes the difference on emphasis in phone and CW now as opposed to what existed when the current frequency divisions were made? Why do you not propose, for instance, to split 80 and 40 meters evenly between phone and cw, and use the new 50 Kc phone segments thus created as the exclusive preserve of the Advanced Class Licensee? This plan, Mr. Huntoon, seems to achieve the end without hurting anyone — what's wrong with it? Why is it not better than yours which proposes to impose all sorts of restrictions? Quote from your June Editorial "and eventually to carry certain additional operating privileges." Quote from July Editorial — "the following misstatement — all General and Conditional Class Licensees will be restricted to CW operation." Deny that though you did, is this not substantially what you reversed field and proposed?

Let's put it another way — I own almost $3,000.00 worth of CW/SSB equipment; if I had been interested in CW only, I could have gotten by for less than one third of the cost. Quote from February Editorial "there is no way to avoid the fact . . . . . that these privileges must be withdrawn from Amateurs who currently have them under the basic amateur license." Mr. Huntoon, do you really expect me to accept this statement from you blindly, unquestioningly, when it is my $3,000.00 that is at stake here; do I not, at the very least, have the right to a full explanation of exactly why you claim your plan is the best? Am I supposed to willingly jeopardize my right to use my equipment without really understanding why I'm doing it? Am I not supposed to question the qualifications and credentials of an organization that arrives at answers other than the obvious?

It's almost possible to believe, Mr. Huntoon, that ARRL purposely created the bitter cleavage that currently divides Amateur ranks; one thing certain is that it is your handling of the incentive issue that is the basic cause of the chaotic conditions which surround us, and that you could have avoided most of it had you tried. Even if your plan is the best solution, why have you not taken more care to sell it to the Amateur fraternity? Why set things up so that attention is forcefully drawn to the division in our ranks? Particularly, why draw the Commission's attention to the hatred some elements of Hamdom feel for ARRL, without making a real effort to try to avoid it? Have you underestimated Amateurs in general, and overestimated your own standing and prestige in particular, and is this mistake not grave enough to be fatal to the League? Has your posture in front of the Commission as

our spokesman been so damaged that ARRL is now a liability instead of an asset? Have you not effectively sawed in half that which you should have been bending every effort to cement together?

I don't pretend to have the answers to these questions, Mr. Huntoon, but they're going to have to be found, and in the near future. Based upon what has happened in allied fields, I believe it is imperative that we, ourselves, reduce thas problem to manageable proportions, and go to the FCC with a solution that has the support of a majority of amateurs, without the vitriol that is currently being sloshed around as if it were nectar.

You've produced a cleavage in the ranks, Mr. Huntoon, from which we will not shortly recover; you've weakened our defenses, rather than strengthened our armaments. If you can explain all this away; if you can answer your critics, fine — let's have at it and do away with the dissension that threatens our future potency. If you cannot weld the seams you've split, step aside and let someone else try.

The best and most illustrative description of your failure is, however, provided by the League's counsel, in the February QST. The last sentence in the second to the last paragraph in your reply comments reads as follows: "Firm guidance and leadership by the Commission at this time is essential." No, Mr. Hunton, you're wrong, dead wrong; firm guidance and leadership is what has been essential from ARRL and we're in the current hassle, with all its problematical ramifications simply because that which you now ask from the Committion has not been forthcoming from you. You're supposed to lead, guide, and direct, Mr. Huntoon; you're not supposed to divide and conquer. You've been rudely unhorsed in recent weeks, and you stand to be unfrocked in the near future unless you come down to earth and provide some answers and possibly some reappraisals.

Cordially,
Milt De Reyna, Jr. K4ZJF
4030 Hallmark Drive
Pensacola, Fla.

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

15-20 METER NUVISTOR PREAMPLIFIER. Need more hop on these bands? This simple to build preamp will bring up those signals. This is particularly good for inexpensive and surplus receivers. See April '63 page 40
W6SFM-1 .... $4.00

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 os~~c~~illator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... $20.00

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a Zener diode. Kit includes even the battery and mini-box. See page 15, Aug. '63.
K9ONT $5.00

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

BOURBON S-METER. Much better than the usual Scotch S-meter. Here is an S-meter kit for those of you with receivers without S-meters. Includes tube, adjusting pot., socket, resistors, and meter. See September 1963 page 18.
W6TKA-2 .... $6.50

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 .... $15.00

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included. See Aug. 62 p 38.
W2LLZ $13.00

RECEIVER-DECEIVER. Substitute local oscillator for your receiver for sideband reception, complete with power supply, tubes, voltage regulator, etc.
W2RWJ $19.95

HAM BAND AUTOMOBILE CONVERTER. Listen to the hambands instead of that rocky-roll junk. Transistor converter, complete with battery, etc., to tune 20 meter band. Crystal controlled.
VE2AUB $6.95

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ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

Ham-RTTY. This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volume 2. Complete library volume containing the 1962 issues of 73. $15.00

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Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

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83—THE SURPLUS HANDBOOK, VOLUME I—Receivers and Transmitters. This book consists entirely of circuit diagrams of surplus equipment and photos of the gear. One of the first things you really have to have to even start considering a conversion of surplus equipment is a good circuit diagram. Tihs book has the following: APN-1, APS-13, ARB, ARC-4, ARC-5, ARN-5 VHF, ARN-5, ARR-2. ASB-7, BC-222, -312, -314, -342, -344, -348, -603, -611, -624 (SCR-522), BC-652, -654, -659, -669, -683, -728, -745, -764, -799, -794, BC-923, 1000, -1004, -1066, -1206, -1306, -1335, BC-AR-231, CRC-7, DAK-3, GF11, Mark 11, MN-26, RAK-5, RAL-5, RAX, Super Pro, TBY, TCS, Resistor Code, Capacitor Color Code, JAN/VT tube index. **$3.00**

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107—THE AMATEUR RADIO HANDBOOK—Published by RSGB. This is a *thorough and complete 540 page handbook* which covers every aspect of amateur radio: tubes, transistors, receivers, transmitters, VHF gear, sideband, FM, antennas, mobile gear, noise, power supplies, and much, much more. You'll find this one suite interesting and informative. **$5.50**

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MCN—MODERN COMMUNICATIONS COURSE—by Noll. Aimed more at commercial radio than amateur, but an excellent book for home study or class work. Covers transmitters and antennas quite well. **$4.95**

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Sixteen states have only one plate this year . . . this is a good time to put a call letter license plate on the front of the car. Specify color of background, color of call, and wording for the bottom line.

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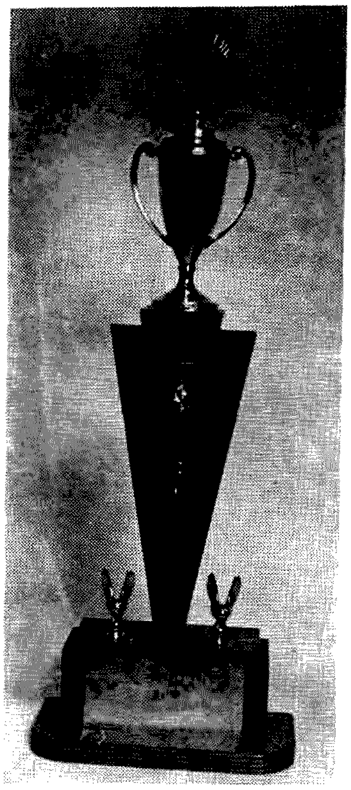


An Award

To Merrill Swan W6AEE

The defunctation of the Edison Award (I don't recall seeing one in 1963) got me to thinking again about the need for a meaningful award in amateur radio. While I agreed with the judges on their selection of Edison winners for most years, there were times when I was disappointed and felt that their selection did not serve amateur radio well.

It came as a shock to me a few years back to find that there were some amateurs who were actively seeking the Edison Award and that this was their goal when they were rendering service to amateur radio and the public. An editor gets to know these chaps quickly for they are constantly seeking all the publicity possible for small acts of service.

There are many amateurs who have devoted a large part of their lives to making amateur radio a better hobby (or service) and I'd like to see these fellows reap some small reward to let them know that we all appreciate the job they have done or are doing. In the interests of bringing recognition to the fellows who are real backbone of our hobby the Institute of Amateur Radio is sponsoring an award for those who have done outstanding work in amateur radio.

All amateurs are hereby requested to sit in careful cognitation and send in their nominations for any amateur that they feel has done an outstanding job of service, made amateur radio more fun for us, made a significant technical discovery, or has in any way made amateur radio a better hobby or service. The most likely nominations will be published each month in 73 and members of the Institute will be asked to send in their vote for the person they feel should be given the award. Winners will be announced in 73.

By way of getting the Institute Outstanding Amateur Award off to a good start the first Award has been made to Merrill Swan W6AEE for his work in the cause of amateur RTTY. Merrill has devoted his life for well over ten years to RTTY and has been responsible in a large measure for its remarkable growth. He has edited and published the RTTY bulletin for over ten years, been instrumental in the distribution of hundreds of teleprinters to amateurs all over the country, brought about new and important technical developments in RTTY converters through his own work and the encouragement of others, traveled widely to speak to groups and help individuals in furthering his cause, and has been a true pioneer in this field. His work and achievements are in the best traditions of amateur radio and we all can be proud that we have amateurs of this stature. Merrill Swan W6AEE, we salute you and offer you the Institute of Amateur Radio Outstanding Amateur Award as a symbol of our gratitude.

Please, in sending in your nominations, give as much information as possible on the activities of your nominee so the Institute members will be able to make the wisest choice for the Awards.

San Marino

A letter from DJØHZ Al Brogdon tells us how he managed to get a license to operate from San Marino. You write a letter, in Italian, to Ministero Poste e Telecomunicazioni, Ispettorato Generale delle Telecomunicazioni, Direzione Centrale dei Servizi Radioelettrici. Divisione 1A, Roma, Italy. This will help speed you through customs at the Italian border and grant you permission to operate in San Marino. Allow three months, at least, for the red tape to unfurl. Also include the dates of anticipated operation, frequency bands to be used, transmitter output, proposed location and a photocopy of your home license. Al got the letter just days before scheduled operation, got through the borders all OK, took the letter to the local police department in San Marino and registered himself and station. Since no actual call was assigned (they sugegsted he select a 9A1 call, but the M1 prefix was still OK), Al took M1M (fine for CW) and during three days satisfied 1400 DX'ers.

Propagation Charts March 1964

Good: 1-2, 8-9, 14-16
Fair: 3-5, 7, 13, 22-25, 30-31
Poor: 6, 10-12, 17-21, 26-29

***Means next highest frequency might be useful.**

J. H. Nelson

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	7	7	3.5	3.5	3.5	7	7	7*	14	14	14
Argentina	14	7*	7	7	7	7	14	21	21	21	21*	21
Australia	14	14	7	7	7	7	7	14	14	7	14	14
Canal Zone	14	7	7	7	7	7	14	14	21	21	21	21
England	7	7	3.5	3.5	3.5	7	7*	14	14	14	14	7
Hawaii	14	7*	7	7	7	7	7	7	14	14	14	14
India	7	7	3.5	3.5	3.5	7	14	14	14	7*	7	7
Japan	14	7	7	7	3.5	3.5	7	7	7	7	7	14
Mexico	14	7	7	7	7	7	7	14	14	21	14*	14*
Philippines	7	7	7	7	7	3.5	7	7	7*	7*	7	14
Puerto Rico	14	7	7	7	7	7	14	14	14	14	14*	14
South Africa	14	7	7	7	7	7*	14	14	21	21	21	14
U.S.S.R.	7	7	3.5	3.5	3.5	7	14	14	14	7*	7	7

CENTRAL UNITED STATES TO:

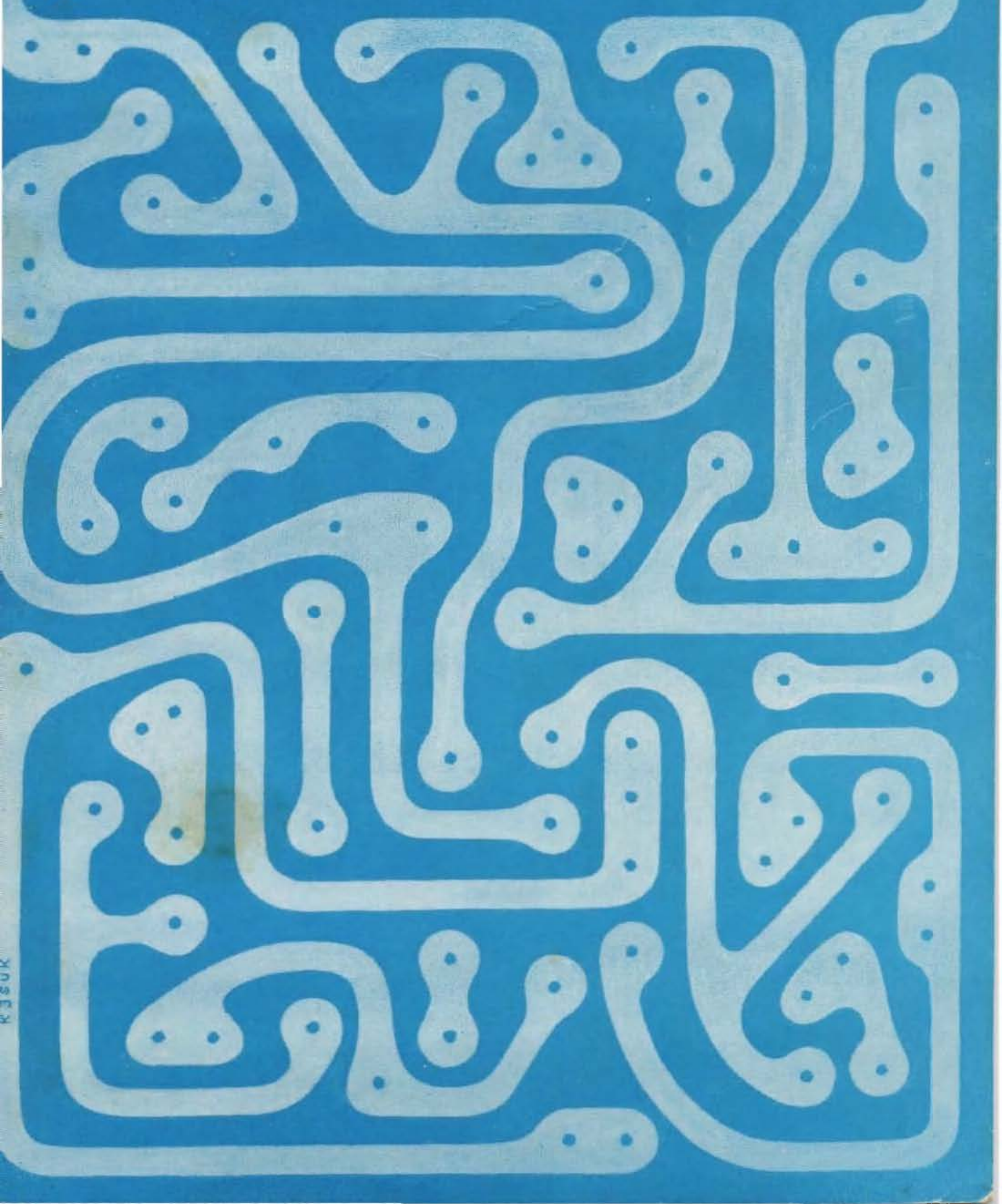
GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	7	7	3.5	3.5	7	7	7*	14	14	14
Argentina	21	14	7	7	7	7	14	21	21	21	21	21
Australia	21	14	7*	7	7	7	7	7*	14	7	14	21
Canal Zone	14*	14	7	7	7	7	7*	14	21	21	21	21
England	7	7	3.5	3.5	3.5	3.5	7	7*	14	14	14	7
Hawaii	14*	14	7*	7	7	7	7	7	14	14	14	14
India	7	7	7	7	3.5	3.5	7	7*	14	7*	7	7
Japan	14	14	7	7	3.5	3.5	7	7	7	7	7*	14
Mexico	14	7*	7	7	7	7	7	14	14	14	14	14
Philippines	14	14	7	7	3.5	3.5	7	7	7*	7*	7	14
Puerto Rico	14	7	7	7	7	7	14	14	21	21	21	21
South Africa	14	7	7	7	7	7	14	14	14	14*	14*	14
U.S.S.R.	7	7	7	7	3.5	3.5	7	7*	14	7*	7	7

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
Alaska	14	14	7	7	7	3.5	3.5	3.5*	7	7	14	14
Argentina	21	14	7*	7	7	7	7	14	14	21	21	21
Australia	21	14*	14	7*	7	7	7	7	14	7	14	21
Canal Zone	14	14	7	7	7	7	7	14	14	14*	21	21
England	7	7	3.5	3.5	3.5	3.5	7	7	14	14	7*	7
Hawaii	21	14*	14	7	7	7	7	7	14	14	14	21
India	7	14	7	7	7	7	7	7	7*	7*	7*	7
Japan	14	14	14	7	7	7	7	7	7	7	14	14
Mexico	14*	14	7	7	7	7	7	14	14	14	14	14*
Philippines	14	14	14	7	7	7	7	7	7	7*	7	14
Puerto Rico	14	14	7	7	7	7	7	14	14	14*	14*	14*
South Africa	14	7	7	7	3.5	7	7	14	14	14	14	14
U.S.S.R.	7	7	7	7	7	3.5	7	7	14	7	7	7

73 AMATEUR RADIO

APRIL, 1964
40c



73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

April, 1964

Vol. XVIII, No. 1

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de W2NSD/1

never say die

My editorial last month nudged enough skeletons so that I knew we'd have to have an answer of some sort from the ARRL. Sure enough. Affiliated clubs received a letter from Huntoon claiming that the Geneva administrative conference positively will not be held in 1965. Though this is contrary to the reports I've had on a confidential note from State alerting other agencies to be prepared for the possibility that an administrative conference might be added to the plenipotentiary conference in 1965 since all of the delegates will be on hand anyway. The later the administrative conference the better for us . . . I hope they turn out to be right. I, frankly, feel that we should expect the worst and work hard to be as ready as possible. If we have more time then we are just that much ahead.

Hunty reassured us all that Hoover will remain president of the League. I think I can speak for all ARRL members in commending Herb for sticking to the ship in time of storm. We were all dismayed to read in the March issue of QST that membership in the ARRL dropped off last year . . . possibly for the first time in history except for war time. We'll all be watching very carefully to see if things are straightened out enough this year so the thousands who have threatened to drop out of the ARRL change their minds.

The letter also claimed that it would be months before the FCC would give any answer on RM-499. Well, one way to handle a hot potato is to let it cool off first. I hope that we will see something soon, before ham radio is further pulled apart by this ill-considered action. I think that the League should exert their influence to help speed up this action, not slow it down.

The revolution brought on by the incentive licensing hassle was felt in some areas of the country during the last ARRL elections when Tom Moss W4HYW and Phil Spencer W5LDH won the elections in the Southwestern and Delta Divisions. I'd like to see some more fellows on the ARRL Board of Directors with some gumption . . . it is just possible that some dynamic leadership could get the League going again and eventually have it resume representation of the amateurs.

This fall the League will hold elections in the Central, Hudson, New England, Northwestern, Roanoke, Rocky Mountain, Southwestern and West Gulf Divisions. If you meet the qualifications to run for Director and you are willing to put up a fight to get ham radio back in shape why not seriously consider running. I hope that this year we will be able to devote considerable space in 73 to the qualifications of the aspirants to Directorship so members won't have to make their decision on the basis of a short and perhaps hopelessly biased biography which comes with the ballot.

To qualify under the present rules you must have been a League member continuously for at least four years (with not even a one day lapse in membership) and you must not be in the radio industry. All you have to do to run is get the signatures of ten League members on your petition and then visit as many clubs in your division as you can to round up votes.

I have a few other hints which some of the past directors claim are sure fire for election. As far as I know none of them that knew the formula ever lost an election.

The petitions for nomination don't have to be in until September, so you have lots of time to talk this over on the air and at club meetings and get some fellows interested who can get in there and straighten things out. I'm interested in hearing from anyone who wants to give this a try.

Catalogs Are Free

Though I haven't mentioned it recently, advertising is still the life-blood of magazines.

This means that whenever you write to an advertiser and mention that his ad in 73 brought you to him that we will be able to run just that many more pages in future issues of 73.

Though advertiser after advertiser tells me that 73 is the best pulling magazine of all for direct sales and for the sale of new equipment, we seem to lose out every now and then on catalog distribution. Fellows, how can you get along without some of the basic catalogs? I have several that I keep right at hand all the time . . . I wouldn't be without 'em. If you'll just send for a few catalogs and perhaps get a few fellows you talk to on the air to send in too, we will be in good shape.

How can you be without the Allied catalog? It's the largest in the business. Write Allied Radio, Department 73, 100 N. Western, Chicago 80, Illinois. Just a QSL card will do it fellows.

Next you'll want to get the Lafayette catalog. Lafayette not only has a whole line of ham gear, but they import terrific little gadgets from Japan that you can't get elsewhere. I order stuff from them every day. Lafayette Radio, Department 73C1, Syossett, L. I. N. Y.

While you're cataloging drop a card to Heath, Dept. 11-1-1, Benton Harbor, Michigan. Heath has so much new stuff that it is hard to keep up. I'm still kicking mystelf for letting some of their past equipment be discontinued before I latched onto it.

Another dandy catalog is the one from International Crystal, Dept. 73, 18 North Lee, Oklahoma City. Oklahoma.

Leo, out there in Iowa, has a fine ham catalog. Write World Radio Labs, 3415 West Broadway, Council Bluffs, Iowa. Tell Leo that 73 sent you.

Texas Crystals will be upset if you don't get one of their new catalogs . . . you will be too, when you find what you've missed. Well worth the effort. Texas Crystals, Dept. 73-4, 1000 Crystal Drive, Fort Myer, Florida.

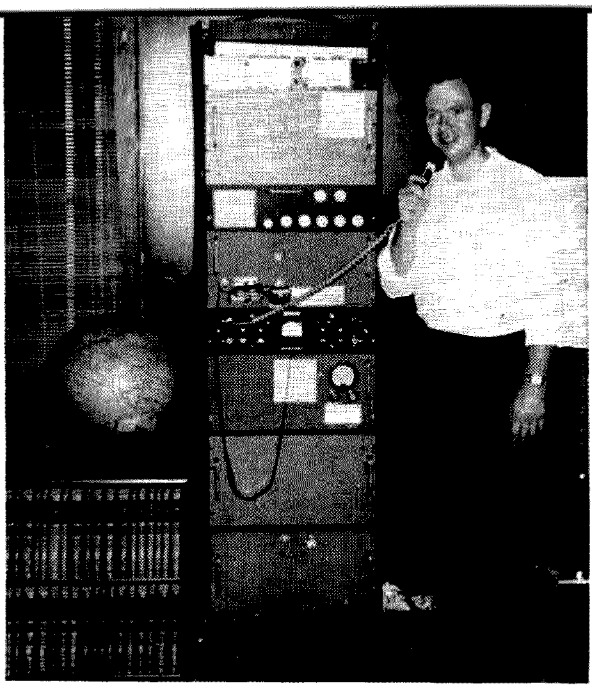
Not only will this make all these companies happy, but you will get just that much more mail.

More Help

Between the extra work brought on by the Institute of Amateur Radio and the loss of four staffers due to draft board handiwork we are still looking for fellows to come up here and work with us. We don't need experience as much as intelligence and versatility. Fel-

(Turn to page 88)

The Los Angeles Repeater Six Meter



The author and the repeater. Panels, top to bottom: 1) Preselective LC tuned filter 2) Six meter receiver 3) Audio panel 4) Tape deck 5) Modulator 6) 220 mc control receiver 7) Control panel 8) Six meter Transmitter

Douglas Sherman K6VWM
5438 4th Avenue
Los Angeles 43, California

In December of 1959, within the confining walls of Los Angeles City College, a momentous decision was reached, a decision that was destined to shake the very foundations of amateur radio. A brilliant young physicist (me) and an aspiring young engineer (the other guy) decided to provide a service for the amateurs in Southern California that was heretofore unheard of, and indeed unthought of, throughout the history of mankind! And all this with no ulterior motive, (much)!!

Actually, upon closer examination, it wasn't really unheard of, or even unthought of, and it didn't shake the foundations of amateur radio, but it is a service, and it is offered (toll free) to all amateurs on the six-meter band in Southern California. It's called "The Los Angeles Six-Meter Repeater."

One of the fundamental differences between radio waves of high frequency (HF) and those of very high frequency (VHF) is that the very high frequency waves are not sufficiently affected by the earth's atmosphere to cause them to display the property known as "skip." Both HF and VHF radio waves emanate from the antenna in straight lines, but where the HF waves are returned from the ionosphere, the VHF waves continue on out into the blue. Therefore, the only VHF waves that are useful for communication are the ones that travel along the ground.

Unfortunately, we now run into a very bad design error: The earth is round! To a VHF man, this is very sad news indeed, but nevertheless it is true. Now, the earth being round wouldn't be so bad if VHF radio waves either

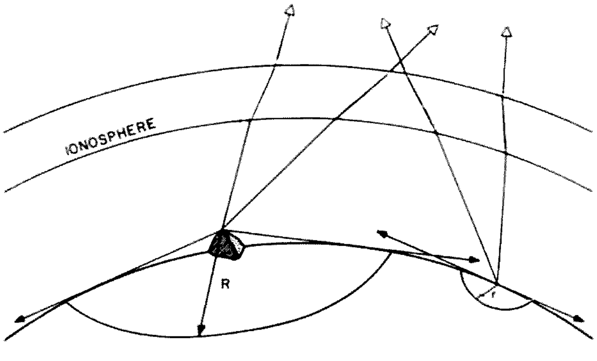


FIGURE I

R = Radius of communciation = 300 to 500 miles

r = Radius of communication = 30 to 50 miles

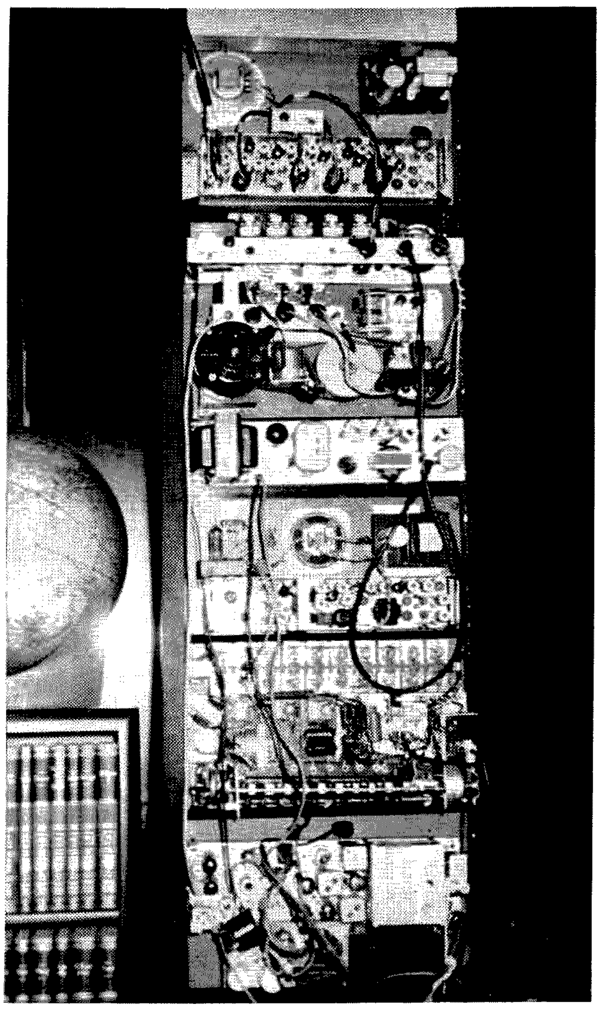
traveled in circles or would always come back from the ionosphere, but alas, they don't. As a result of the straight VHF waves and the round, round world, one can talk, under normal conditions, only a distance of 30 to 50 miles. A nasty trick of nature indeed, and one that had to be reckoned with.

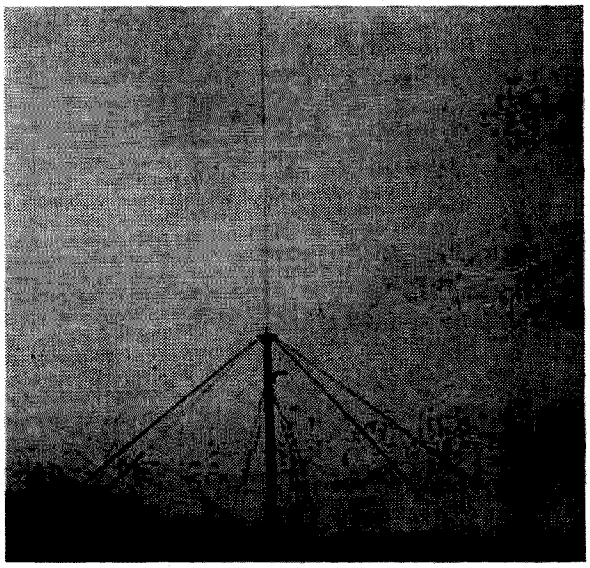
Now it is common knowledge that VHF amateurs are a minority group and as such are discriminated against because hilltop housing is not available to them. However, consider the possibility of a VHF amateur on the top of a tall mountain. Not only he, but his transmitter can see much farther than any of his ground-bound counterparts. See Fig. 1. Unfortunately, not all amateurs can live on the tops of mountains. Therefore they must be satisfied with the meager range that they can cover from their locations.

Being firm believers in the equality of man, and that ground-bound amateurs are just a little more equal than the rest and deserve something extra, we placed a six-meter receiver, a six-meter transmitter, a tape deck for identification, and other circuits that are peculiar to repeater operation, on the top of a mountain. And presto, we had a repeater! Actually that "presto" is quite misleading. Well over 4000 combined man-hours of concentrated work during the months of June, July, August, and September of 1960 were spent designing, building, redesigning, and rebuilding until "it" worked.

A repeater is essentially an instrument that sits on the top of a mountain, listens on some frequency in an amateur band and simultaneously transmits, on a different frequency, everything that it hears. It effectively puts every amateur using it on top of the mountain. The Los Angeles Six-Meter Repeater receives on a frequency of 50.55 megacycles, transmits a 25 watt signal on a frequency of 51.10 megacycles and is controlled on the 220 megacycle band. The repeater has excellent coverage over most of Southern California. It has been copied by an aeronautical mobile over Phoenix, Arizona. The signal there was S9 at heights over 100 feet and eventually dropped into the noise at about 50 feet above the ground. The signal has been reported as S9+ along the beach in San Diego, California, and it is easily copyable mobile in downtown San Diego. The repeater provides excellent coverage of the San Fernando Valley but unfortunately it does not provide coverage north of the range of mountains separating the San Joaquin Valley from Southern California. We also have trouble getting into the resort town of Palm Springs, California. The repeater is copyable there, but it is only about S1. Apparently some of the signal is bounced off the side of Mt. San Gorgonio and down into Palm Springs behind Mt. San Jacinto. We have never been able to successfully copy the only six-meter station in Palm Springs. All in all though, the repeater solidly covers an area in excess of 250,000 square miles.

The repeater is built around a modified Motorola 80D receiver and transmitter. This Motorola mobile unit was once part of the Montana Highway Patrol and was purchased indirectly from the Motorola Warehouse in Burlingame, California. The 220 megacycle control receiver is a modified Motorola 5V, which used to be mounted on a police motorcycle. The 220 megacycle transmitter is homebrew and can be found in the ARRL *Radio Amateur's Handbook*. The tape deck is homebrew, but utilizes Concertone hardware and 8 IBM recording heads. The tape deck accommodates one inch wide tape, upon which there are 8 possible recording tracks matching the 8 IBM recording heads. On one of the tracks one finds voice identification; MCW identification is on another track. There are 6 tracks left





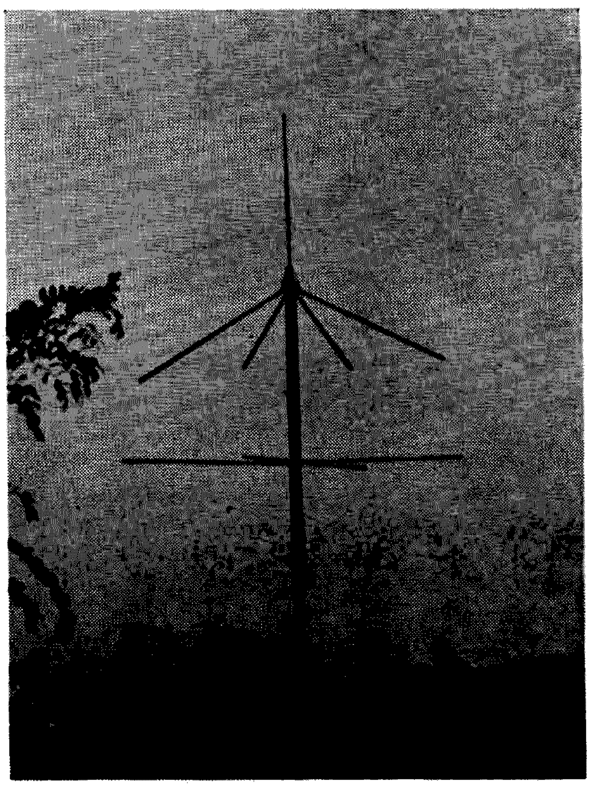
Six meter communicator

for experimentation, special seasonal messages, etc. The tape is in the form of a loop and is automatically cycled once every five minutes when the repeater is in operation. It has been found that MCW identification is far superior to the voice method. With MCW identification, the weakest stations can be copied but the voice identification blanks out even the strongest stations. The identification was made very strong because it was found that the FCC is very sensitive about weak identification in repeater applications.

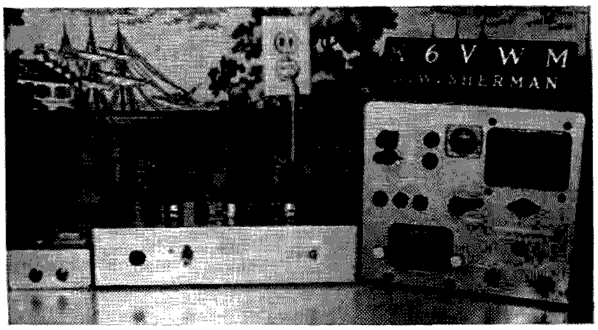
In repeater operation, the transmitter remains on the air whether or not anyone is on the input channel. (There is one exception to this that will be discussed later.) It is sometimes difficult to tell when an amateur removes his carrier from the input channel because the noise level at the repeater is always very low. To facilitate the realization of this and provide a guarantee of break-in capability, a 2 second delayed beep tone circuit was built and installed. This circuit waits for two seconds after a carrier has been removed from the input channel, and then puts a 600 cycle sawtooth wave on the output of the repeater transmitter. This serves as a signal that a carrier has just left the input channel and that the repeater is clear for another transmission. The two seconds of silence enables any break-in stations to identify and make their desires known. All stations using the repeater are requested to wait for the beep tone before each of their transmissions. The break-in stations do not wait for the beep tone but come in before it comes on. Because of this break-in capability, many emergencies have been given immediate attention and several lives have undoubtedly been saved.

The repeater was first put into service at about 8:00 pm on December 25, 1960. That was a night that will long be remembered. For two weeks previous to that date, the repeater sat in a garage and ran 24 hours a day loaded into a lightbulb without any failures. Then it was installed in the Baldwin Hills and manually put into operation. It was functioning perfectly. We came back down the hill to the control point and decided to put it through the acid test of remote control. The necessary 220 megacycle information was sent and it obeyed perfectly; or so it seemed, at least it went off the air. Next the information to turn it back on was sent and . . . nothing! Again, and . . . nothing! Thus the first of many hundreds of service trips began. The repeater had had its first dramatic convulsion. Half of the repeater was off, the other was on, the identification tape was going round and round and there were blown fuses all over the place. Nothing serious, just dramatic. Understandable, being its first night away from home and all that.

Initially, due to the need of minor adjustments and minor failures, we were making two and three trips a day up to see the thing. After approximately six months of very tender loving care, the dependability was up to the point where "it" was demanding visits once every two or three weeks. The reason for the excessive care during the early months of its life is that each repeater is a prototype and



220mc antenna



Author's home and control station, l to r: 1) Automatic Combination and Periodic Information Unit 2) 220mc transmitter 3) Six meter transmitting antenna

the one important thing that cannot be designed into it is reliability. This was the reason for the Baldwin Hills location, all of 400 tremendous feet above sea level. As a repeater location it was worthless but as a service location it was excellent, being only a couple of miles away from home.

Initially, there was a lot of trouble with the six-meter receiver. It was badly desensitized when operated in the presence of the transmitter. When the transmitter was modulated over 30% the receiver would literally go out of its mind. Such noises you have never heard; it was unnerving. To solve the problem, selectivity was needed before the signal ever got to the front end of the receiver. For selectivity, a tuned cavity, or tuned LC filter was needed. The commercial Motorola tuned cavity for the 80D receiver costs approximately $500.00. Consequently, an LC tuned filter was designed and built. It didn't completely solve the problem, but things are must better. At least the hideous howls that proceeded from the mouth of the repeater are now forever squelched. We are currently modulating 120% with negative peak clipping.

The repeater, in operation, functions in the following manner: When there is a carrier on 50.55 megacycles, the repeater will simultaneously transmit on 51.10 megacycles any and all information that it hears. When the carrier leaves the input channel, there is approximately a two second period of silence followed by a beep tone. This silence enables break-in stations to be heard easily and also acts as insurance that, in the event of an emergency, the station in distress will be heard and will not be covered up by the next transmission. Also, if the repeater is not used for a period of two minutes, the transmitter is put in a standby position. It can be put back on the air by merely placing a signal on the input frequency, 50.55 megacycles.

The repeater will soon be performing an additional service. A unit is now being designed which I am calling a "D. C. Digital Voltmeter with Audio Readout." A more revealing name might be a "Signal Report Generator." When completed, this unit will enable any amateur on the input frequency to ask the repeater what his signal strength is, his presence on the repeater constituting the asking of the question, and when he goes off the air, he will get a series of audio frequency beeps different in frequency from the beep which follows the two second delay after every transmission. Each beep will indicate 3 db of signal above the noise level at the repeater location. Every two beeps then will indicate 1 S unit. The repeater is most useful in mobile work because it is strong enough to blank out all ignition noise and make mobile armchair copy possible over previously unheard of distances.

The outward operation of all repeaters is, in general, quite similar. It is the method of control that varies from one repeater to another. It is felt that the control described below is not only unique, but absolutely unbreakable! As you will see, it is a totally new and unique method of remotely controlling a transmitter.

Before we could decide on what was wanted in terms of control, we had to find out how other repeaters were being controlled. The only other repeater in Southern California providing a similar service at that time was the two-meter repeater, K6MYK. It is remotely controlled by a series of tones, kept on the air by means of continuous carrier on the 420 megacycle band, and there are beams at both ends of the link. Although there is nothing really wrong with this type of control, it embodied everything that we wanted to get away from. We wanted to see if we couldn't arrive at something that was completely breakproof and

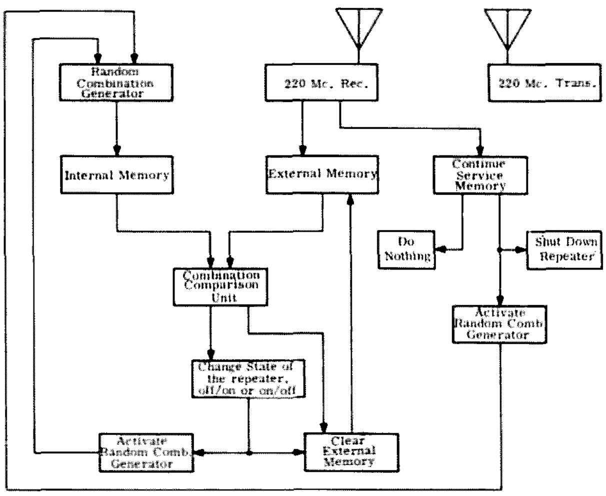


FIGURE 2

yet uncomplicated.

What was wanted was a method that would meet the following requirements: (1) omnidirectional antenna systems at both ends of the link, (2) no tones or modulation of any kind on the control carrier, (3) control information constantly changing in an observationally unpredictable manner, (4) *no* identification of control carrier, (5) absolute frequency secrecy, (6) no continuous carrier control (identification would be necessary). Fulfilling all the above requirements would constitute an absolute, unbreakable control that is in fact quite versatile. Impossible to do? Almost! To help solve the problem, we called upon one of our good friends and former instructors, Mr. Fred Gruenberger, a computer expert at the RAND Corp. in Santa Monica, California. With his help, the system of control that is in use today was developed and found to meet every requirement!

In order to keep the control breakproof, the actual specifics of the control operation will be very lightly covered, but the general principle of operation will be covered in detail. A brief description of each block on the diagram in Fig. 2 will be followed by a more comprehensive description of the control operation.

(1) 220 Megacycle Receiver: Frequency—crystal controlled and ultra top secret, approximately 2 Kc bandwidth, 24 hour operation. (2) Random Combination Generator: Every time the repeater is turned on or off, this unit generates a new set of information needed to turn it off or on the next time, and stores this information in Internal Memory.

(3) Internal Memory: A memory unit for the purpose of storing the information given it by the Random Combination Generator. This memory cannot be affected in any way by the control information that comes over the 220 megacycle channel. The sole determinate of its contents is the Random Combination Generator.

(4) External Memory: A memory unit for the purpose of storing the information given it by the 220 megacycle receiver. This memory can be partially filled, fully filled, or cleared by pulses of 220 megacycle carrier of varying duration.

(5) Continue Service Memory: This is a small memory unit that serves as a control channel failure indicator. If there is a control channel failure either at the repeater or at the 220 megacycle transmitter, this memory unit causes the repeater to be shut down, and also activates the Random Combination Generator unit so that a new "set" of information will be required to turn the repeater back on after the

trouble has been corrected.

(6) Combination Comparison Unit: This unit maintains a constant 24 hour comparison of Internal and External Memories. When they contain different information, this unit clears External Memory and does nothing else. However, when they contain the same information, the repeater is turned *on* if it has been *off* or *off* if it has been *on*. Then this unit activates the Random combination Generator so that it will generate another "combination," and it clears External Memory.

A slightly more detailed discussion of the total control circuit follows.

The overall picture of the control is not much different from that of an electronic combination lock that changes its combination every time it is used. Each combination consists of not just 3 numbers but is actually made up of many digits. Every new combination is, to the observer, unpredictable. This affords sufficient protection against anyone's tape recording our signals and gaining control, because once a combination is used, it is no longer valuable.

As far as outside observations are concerned, the changes are random in nature but, in reality, they are not random changes and the new combinations can be predicted, provided one has inside information on how the Random Combination Generator is constructed and the principle upon which it operates. A program was run on the IBM 7090 computer which gave us over 5000 years of combinations in their proper order, and I intend to use every one of them!! It may seem unbelievable but the Random Combination Generator can generate over five hundred trillion (539, 682, 289, 432,-600) combinations that are seemingly unrelated to each other before the sequence of combinations begins to repeat as a whole. It is evident that by using two combinations per day, one to turn it on and one to turn it off, that it would take in excess of 51 billion years to exhaust all the possible combinations. A little overdesigned perhaps, but it does the job. (We had an immortal repeater in mind at the time.)

Perhaps the randomness of the combinations alone would have assured an unbreakable control, but more is yet to come; read on. Anyone could listen to the control transmissions only if they found the frequency on which we operate. Our next move was to transmit the control information in such a manner as to maintain absolute frequency secrecy. This was done by designing the control panel to accept the needed information in terms of nothing but pulsed 220 megacycle carrier. To comply with FCC regulations concerning the operation of a transmitter on the 220 megacycle band, for the purpose of remote control, without identification, the length of any one pulse transmission was kept less than that which would require identification. Pulsed CW transmissions on the 220 megacycle band for the purpose of remote control need not identify if the transmission length is less than 10 seconds.

The combination of short transmissions, pure carrier, no identification, and extreme selectivity in the control receiver assures a virtually undetectable control and therefore an unbreakable control.

The method of shutting down the repeater appearing on the logic block diagram, that is, sending the new combination, is not the only way it can be done, but it is the fastest way of ceasing the service. Of course, in the event of an emergency this is the method that would be used. Now for another method. Once the repeater has been activated, it must receive periodic information in order to continue the service. This information is fed to the Continue Service Memory unit through the 220 megacycle receiver. Again this information is pure pulsed carrier. If the Continue Service Memory unit does not receive this pulse information in any one of the time intervals in which it is expected, the unit will assume that there has been a control channel failure, promptly shut the repeater off, and cause the Random Combination Generator to change the control information to a brand new combination. With this method, when one desires to turn the repeater off, he just stops sending the periodic information to the Continue Service Memory unit. This method of control can be, and is, often used to let the repeater slip out of service.

With the method of control outlined above, the FCC gave their unprecedented approval of the remote control of a transmitter with omnidirectional antenna systems, and without continous carrier control. The biggest advantage is obvious, the control can be taken mobile. A 30 watt 220 megacycle transmitter could solidly control the repeater from as far away as San Diego. The first such mobile control will be running shortly.

Although there is nothing really complicated about the control, a great deal of attention was initially demanded of the controlling operator. The combinations and the periodic information had to be sent manually. Being intrinsically lazy and a lover of the push button, I designed a small unit that would do all the work at the mere touch of a finger. It can be seen immediately to the left of the 220 megacycle

control transmitter in the photograph of the author's home and control station.

At first, the logging of all the stations using the repeater was quite a chore, but that too was overcome. Now, not only the calls of the stations using the repeater, the time that they used it, and the operating time of the repeater itself is logged, but every word passing through the repeater is logged. This is done by means of continuous tape logging. The logging machine uses 5000 foot rolls of one inch wide tape passing by the dual stereo heads at a speed of seven eights of an inch per second. By choosing the appropriate portion of the two stereo tape heads and indexing them four times across the one inch wide tape, a total of sixteen recording tracks are used. At seven eights of an inch per second you wouldn't want to record the London Philharmonic Orchestra, but for logging the repeater it works fine.

In summary, the Los Angeles Six-Meter Repeater was placed in service at approximately 8:00 pm on December 25, 1960. Its first home was in the Baldwin Hills between West Los Angeles and Inglewood, California. The altitude was only 400 feet or so above sea level but it was an excellent location to provide the tender loving care that it needed so badly during the early months of its life. After about 6 months the reliability had improved sufficiently so that we felt it was ready for a higher home.

It was moved to its present location in a private home in the Santa Monica Mountains in Beverly Hills, California on June 6, 1961. The location is roughly one mile east of Laurel Canyon and about one mile north of the of the Beverly Hills business district, at an altitude of about 1700 feet above sea level. It has been in its present location for approximately 20 months and requires service on the average of once a month. We are quite fortunate that the gentleman in whose home the repeater is located is dedicated to the repeater cause because for the past 20 months the repeater, a seven foot, four hundred pound monster, has been sitting in his kitchen!!

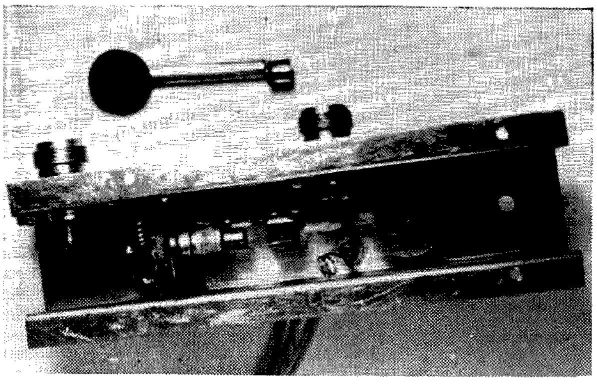
Our deepest gratitude to Mr. Gruenberger and all those who have helped us in this endeavor and without whose help the Los Angeles Six-Meter Repeater might never have become a reality. The service of the repeater will continue to grow and it is hoped that it will become a valued tradition among the amateurs on six-meters. This is evidently becoming a reality also because, from the results of a recent survey, it was found that approximately 75% of all the QSO's that take place in Southern California on six-meters take place on the repeater!!

1296 mc RF Receiving Amplifier

Augusto Lovisolo I1LOV
Malnate, Varese, Italy

Description

Not long ago a receiving radio frequency amplifier at this frequency would have been out of question for the average amateur, since suitable tubes were unavailable or too expensive. This amplifier is built around the new 8058 nuvistor triode and, so far, has given very satisfactory results. Theoretically, an rf amplifier like this ahead of a *really working* crystal mixer should not noticeably improve the noise figure. It is very difficult to make a crystal mixer work as well as it should because of too many factors involved: antenna coupling, varying characteristics in crystals, injection current and so forth. This amplifier was tried and is actually working ahead of a 1N21B mixer and the improvement it makes is quite noticeable.



1296 mc rf amplifier. Plate line removed to show simplicity of construction.

The circuit is simple: the antenna is capacitively coupled to the cathode which is untuned, while the plate circuit is a half wave line fed at the low rf point and tuned at the end. The amplified signal is capacitively coupled out of

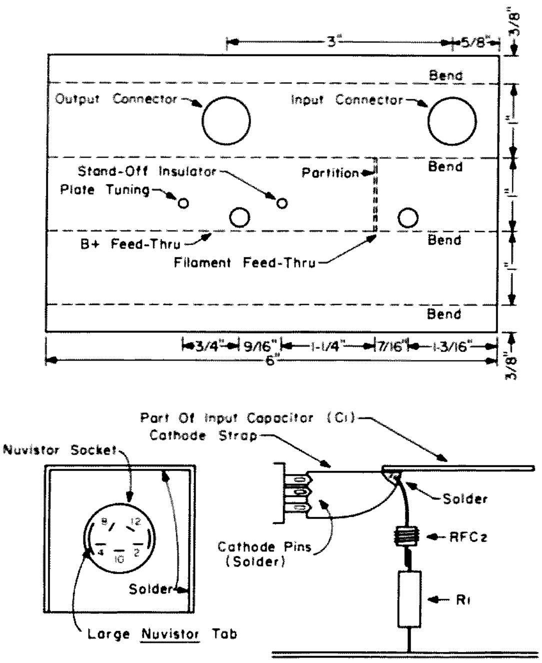


Fig. 1

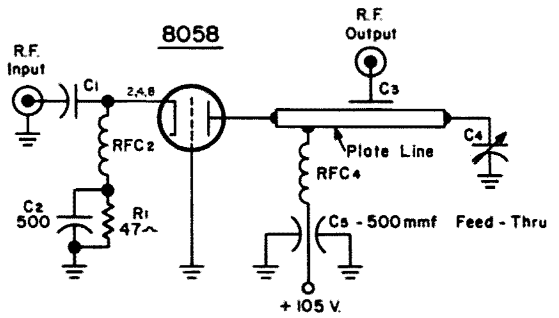
the line in order to minimize loading effects which would lower the Q of the plate circuit.

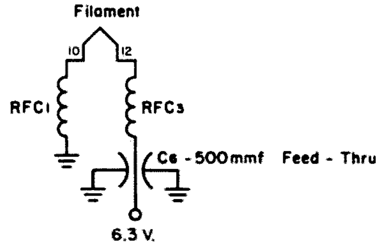
Construction

The amplifier is built into a brass or copper trough, the dimensions of which are given (Fig. 1). The easiest way is to cut the brass plate, drill it and then bend it as shown. The cathode input capacitor is made of tabs, one of which is directly connected to the cathode pins of the tube socket through a cathode strap which is soldered to one tab at right angles (see Fig. 1 and picture). At the point where tab and strap are soldered together, there is the connection of RFC2. The partition is cut out of sheet copper or brass: drill it in the center for the nuvistor socket, solder the socket as shown in Fig. 1 and then solder the partition in place. The plate line is held in place by a clip soldered to it which connects to the 8058 plate cap and by another fuse clip which is mounted on a ceramic standoff insulator. Plate B plus goes to this clip through RFC4. This mounting of the plate line allows for quick and easy removal of line and nuvistor. The plate tuning condenser is made of two disks cut out of sheet copper: one is soldered to the plate line, the other on a screw which runs on a nut soldered on the outside of the trough. RFC1 is wound over R1.

Operation

Plate voltage should be 105 volts, filaments 6, 3 volts. Experimenting with lower plate





voltages could lead to a better noise figure. The amplifier is very stable, since the 8058, with the grid connection coming out on the entire socket, lends itself to grounded grid circuits. Before working properly, the tube must warm up for at least ten minutes. This time is needed for the transconductance to go up. Connect the amplifier to the converter and and to the antenna and tune the plate condenser. At one point you should notice a small but definite increase in noise; the amplifier is now working on the frequency to which the converter is tuned. The best way to align the input and output condensers is to bend them one way or the other while listening to a weak modulated signal. I mean, the best way if you don't have a noise generator at this frequency. Tuning the input circuit of the mixer can be of help too.

So far, I have only used this amplifier with crystal converters, so I do not know how it could behave ahead of a wide band receiver like the APR5 or the APX6. It should work changing C3 with a link which would lower the Q of the line and widen the band of frequencies received with one setting of C4.

. . . I1LOV

Parts List

a) Output coupling capacitor tab C3, copper sheeting ½" x ⅜" and soldered in center to output coupling connector.
b) Plate line ceramic stand-off insulator, ⅜" dia., ⅝" high.
c) Plate tuning capacitor C4 (two required), copper sheet ⅞" dia. round.
d) Plate line. ¼" copper tubing 2" long. Plate feed point is ⅜" from tube end of line.
e) Input coupling capacitor tab, ⅜" x ⅜" solder to input connector. Part of C1. Copper.
f) Input coupling capacitor tab, ⅜" x 1". Other part of C1. Solder one end to cathode strap. Copper.
g) Cathode strap. Cut a small piece of copper sheeting 5/16" x ⅝", trimming away one side until it looks like a small knife blade. This is used to connect pins 2-4-8 together and solders at right angles to (f).

R1 47 ohms
C2 500 mmfd
C5-C6 500 mmfd feedthrus
RFC1-4 4 turns #30 copper wire ¼" dia.

Letter

Dear Wayne,

In December "73" you had the interesting article by K6CTV/4, for which I have been waiting and lots of other interesting stuff, but I am protesting the VE3AZX article. Actually, W6WYD disposed of the "negative cycle loading" myth in Viney's reference (p. 48 May 1962 QST) and furnished some good reasons (non-linear **B H** curve for the modulation transformer core, or improper modulated amplifier operation) for modulator unbalance. VE3AZX, in dividing O by O and coming up with infinity is commtting an arithmetic sin. His particular care of O/O occurs immediately after and immediately before conditions of 5000 ohm load, and by the usual rules, he could assume that his O/O might be evaluated as 5000—certainly there is no reason to call it infinite. Part of the confusion comes from the fact that the modulated amplifier's plate supply is the audio and DC sources in combination. Since these two supplies in series will act the way they do if, instead of the final amplifier's D-C plate circuit they feed a constant plain old resistor of 5000 ohms, it is apparent that for the behaviour charted, they do see 5000 ohms—ALL OF THE TIME!

The exception occurs during overmodulation when the instantaneous supply polarity is reversed and the load does become infinite. With proper operation, we never actually reach a full 100% (it's too hard to keep from splashing over and 80% is undistinguishable from 100% to the human ear—or our clipper prevents it), so conditions for overmodulation are not of significance.

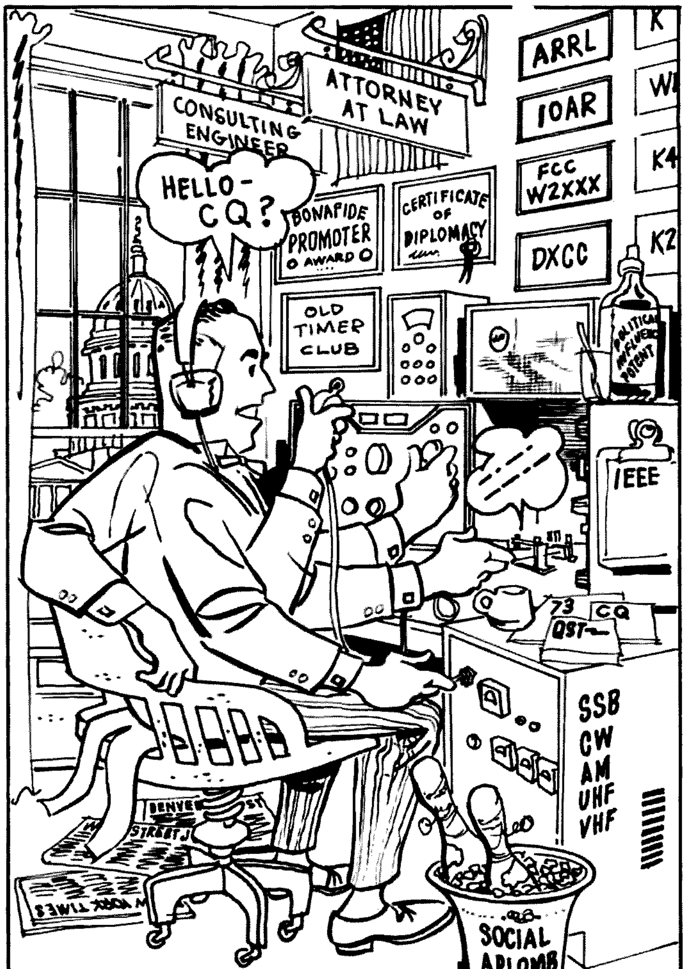
On page 78, he hits the nail on the head: ". . . how come none of the commercial transmitters use it?" Because, to reply in the words of W6WYD, it corrects for a condition that does not exist.

It is significant that the circuits which Viney claims will be benefitted by his hook ups are in transmitters using small transformers. In any case, two wrongs, as the old cliche goes, don't make a right, so the diode is not necessarily the correct approach.

If the assymmetry is in the audio system, no carrier shift exists and the modulating function is, while not the same as that coming from the microphone, not severely distorted. If carrier shift exists, causing this assymmetric modulation no amount of working on the primary side of the transformer will correct it. Remember, also that we have somewhat lopsided voices, so that proper audio polarity may alleviate matters.

To borrow W6WYD's words, the systems proposed by Viney serve only to waste power and increase complexity, both of which we can do without!

73,
Bob Schoening WØTKX



Our Man in Washington
THAT RARE COMBINATION

To be or not to be, that is the question. Or where do we go from here. This subject of an Amateur Radio headquarters and our man in Washington is not a new one. It's as old as Amateur Radio. Old issues of QST and minutes of AARL Director meetings make interesting reading on this important subject. It seems that displacement of people and sentiment as to where we started have been key issues in the past. The importance of location has been secondary to us, yet most of the prominent and important users of the rf spectrum are all located in Washington. In addition to our own political life focused in Washington, we find the embassies of all the countries who also are looking for their slices of the spectrum. In addition to the lobbies that are directly protecting their spectrum allocation, you have many others that indirectly use the spectrum such as the Aircraft Owners and Pilots Association, Trucker's Assoc. and still hundreds of others such as American Rifle Association, etc., etc.

Wells Chapin W2DUD
118 Woodmancy Lane
Fayetteville, N. Y.

Our Man in Washington

Let's ask ourselves, is a man necessary? A good yardstick to measure by is what are other services doing that use this valuable spectrum we are part of. Who has Washington representatives? Do they just have an attorney or do they have offices and a man or men or women to represent them? Do they have public relations people in Washington? etc., etc. Examining a few of the groups to see who have Washington Assoc. Headquarters, we find that the very fine Bible of the Broadcasting Industry for 1963 is a valuable source. This is an excellent document, as believe me, this industry knows how to keep what they have and get what they want.

The following groups are listed in alphabetical order. These cover spectrum allocation only. There are a great number of additional lobbies for other purposes. Ninety-nine per cent are in Washington.

ARRL, Hartford, Conn.
Armed Forces Communication Assn., Washington;
Assn. of Communication Consulting Eng., Washington;
Assn. of Maximum service Telecasters, Washington;
Canadian Assoc. of Broadcasters, Washington;
Clear Channel Broadcasters Service, Washington;
Daytime Broadcasters Assoc., Washington;
Electronic Industries Assoc., Washington;
Federal Communication Bar Assoc., Washington;
International Assoc. Broadcasters; Washington;
IFRB, Geneva;
Joint Council on Educational Service, Washington;
JATAC, New York;
National Assoc. of Broadcasters, Washington;
National Assoc. FM Broadcasters, Washington;
National Community TV Assoc., Washington;
Television Study Alloc. Organization, Washington.

Let's discuss several of these associations. All have some axe to grind for their service. These people use parts of the whole spectrum and

all are sandwiched in or vice versa with our amateur service.

For instance, a classic example of what a good association can be is the Clear Channel Broadcasters Service. This Washington group has successfully defended the clear channel broadcast station's position for over 25 years.

Another good example of a very fine organization is the Association of Maximum Service Telecasters. This group is doing a very fine job of seeing that we TV viewers get good TV reception. It is interesting to note that this group was formed after channel one was deleted from your TV set and mine.

The Electronic Industries Association is a most important group. It consists of the major manufacturers and others. They provide a very valuable impartial service to the electronics industry and in general are a real factor in what the pattern of electronics follows. It is interesting to note that most of your major amateur equipment manufacturers belong to this group who must consider all services. Thus, it is easy to see that on the one hand, an amateur equipment manufacturer loves and sells to amateurs while on the other side of the coin, their livelihood depends upon the needs of the military and commercial interests. You find many amateurs among the regular employees of this very useful, important, and fine group. The names associated with this group are the tops in industry.

The Federal Comm. Bar Association is a group of attorneys whose sole work in most instances is to obtain a place in the spectrum for their services. This is the group that most practicing FCC attorneys belong to. These FCC attorneys in some instances represent other associations (and there are many associations) in frequency allocation problems for their total industry such as truckers, taxis, and the oil industry. These attorneys are in turn hired by all the other associations mentioned in this article. This is indeed a very important group whose interests are very diversified. Among this group you find some very competent famous names. They are all very sharp men who know this allocation problem. Many are avid amateurs.

The Consulting Engineers and attorneys who do FCC work are pretty generally located in Washington. All the other lobbies who have Washington offices, such as the transportation industry group, generally have in their hire on a retainer basis, very competent law and consulting enginnering firms who are also in Washington. Typical for instance is all forms of mobile communication for police, fire, taxicabs, truckers, etc., etc. There is not a single

portion of the spectrum that has not one or more services looking at it or operating in it.

It's rather obvious that we amateurs are mavericks—all those outfits that really want to hold onto what they have are where the action is. Further, it would seem to me, that Amateur radio, with its world wide implications and its importance as one of the tools of peace and good will, would have its headquarters in the place the world knows is our Capitol.

OK—so we should have a man in Washington—this would appear to take a pretty good man—we want our best foot forward. So what are the important attributes this man must have?

1. He preferably must be an amateur-active and well known man—a non-controversial type.
2. He must have the standard attributes of of personal acceptance of appearance, likes people, sales type, a joiner and above all a diplomat.
3. He must be an avid amateur and be very familiar with our past.
4. He must be a planner (to protect our future).
5. A good businessman.
6. Understand promotion and public relations work.
7. Be politically astute and acquainted.
8. Speak French and German. Naturally, English HI.
9. An engineer with a good spectrum allocation background, both FCC and world-wide.
10. Acceptable to the ARRL-CQ-73. Member of ARRL and IOAR.
11. Willing to travel.
12. An avid reader.
13. This man must be acceptable to all amateurs.

By now you are convinced that the above description just fits you. Hi. It will take quite a man to fill this Washington post. So why not dive in and describe what you think the man should be like—maybe even as basic as to voice your opinion as to how you feel about Washington representation. I'm sure Wayne Green will pass on your letters to me to start a series of "letters re our Washington Man." This type of thing should make interesting and important reading for the 73 readers.

. . . W2DUD

Under the Noise

W2NSD/1

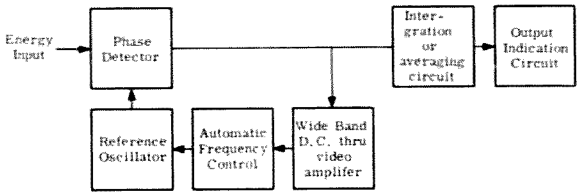
Bill Ashby **K2TKN** has been working hard at digging down deeper and deeper into the noise after weak signals. His article on synchronous Detection in the September 1962 issue of 73 started a lot of fellows thinking about the subject. Now Bill has come up with a breakthrough in the field which permits the best laboratory receivers to dig down another 30 db and come up with copy.

Below is an extract of the information contained in the patent application, which should give you a good idea of the theory involved. A fuller explanation, written in ham-style and avoiding the math that normally would be a part of an engineering paper, will be found in the April issue of 6up along with a complete schematic diagram of a practical operating unit. We plan to run this in the May issue of 73 as well, but Bill wanted to make more of the VHF men aware of 6up and asked that it be published there first.

The input of the working unit is designed to take the 50 kc *if* output of your receiver and change this into a dc signal for operating a relay or a code oscillator. In operation Bill reports that when he tunes what sounds like an absolutely dead twenty meter band his Flying Noise-Lock unit finds all sorts of CW signals down under the noise (as well as many receiver birdies never suspected before) and brings them out. Ditto on two meters. This should be fantastic for moonbounce and extended scatter work.

Flying Noise-Lock

A system of reliable detection of coherent continuous wave energy heretofore impossible due to random electron shot noise, commonly termed "Johnson noise." By use of the proper combination of a number of commonly used electronic circuits, either passive, tube or solid-state, each performing it's normal electronic



function, the overall system readily can be made to have a minimum reliable detectable signal sensitivity, in the presence of the inevitable noise caused by electron motion in all high gain electronic systems, heretofore unobtainable.

This Flying Noise-Lock system is unique in that the overall shape of signal plus noise is not used as a prime function, nor is stable phase relationship between that of a standard and the wanted energy necessary for successful operation. A prime function of this system is that certain components of the unwanted noise are utilized to locate and indicate the presence of the desired energy.

The fact that electron motion noise in linear circuits is totally non-coherent in phase and amplitude, yet continuous wave energy has at least partial coherence in phase or amplitude variation allows a system such as this to successfully treat each in a selective manner so that "signal" can be detected in the presence of many magnitudes more of this noise.

Operation of the Flying Noise-Lock system is so radically different that ready application of currently accepted theory of Boltzmans' Constant, pre or post detection bandwidth, integration factors or self and cross correlation detection systems become very difficult to apply or cross-reference.

The entire spectrum of frequencies to be investigated for the presence of desired signal is introduced into the phase detector circuit. If amplified in any manner prior to this point, it must be accomplished in a linear manner with low phase or amplitude distortion. Random energy peaks of noise will occasionally be of the proper phase to result in a pulse of voltage or current output from the phase detector of either positive or negative polarity, depending on its instantaneous relation to that of the reference oscillator. This random output of either polarity is amplified in a linear manner and applied as automatic frequency control to the reference oscillator. A random noise pulse out of the phase detector locks the reference oscillator in phase relationship to it as long as this particular pulse is in the system passband or until it fades out in amplitude. The natural resonant frequency of the reference oscillator, without AFC influence, is centered in the sys-

tem passband, so without AFC information it returns to normal.

Due to the entirely random nature of noise, along with the closed loop relationship between phase detector output and the reference oscillator, output of the phase detector, during conditions of no coherent energy in the system passband, is entirely random in amplitude and polarity.

If, on the other hand, even a very low level of coherent, continuous wave energy is present in the passband of the system, the output of the phase detector becomes a direct current or voltage, so amplified and interconnected through the AFC system as to shift the reference oscillator into a desired phase relationship to increase this direct current output. Random peaks of noise have swept the reference oscillator into close phase proximity and pull it away when they contain more energy than the coherent signal, but due to their transient nature their resultant output from the phase detector tend to cancel out in a simple averaging circuit that readily passes the direct current result from the desired continuous wave energy to an output indicator of any sort.

This unique interconnection of commonly used electronic circuits results in a system that uses the undesired system noise to locate and implement indication of low intensities of desired signal with only vague and odd-order relationships to presently known and recognized techniques, and accompanying theories.

Tracer

Cheap and handy adjuncts to preliminary signal tracing are the two-transistor-one-diode reflex broadcast receivers available for as low as $3.95.

The reflex circuit responds to both audio and radio frequencies, and to convert to signal tracing all you need do is remove the antenna loopstick and substitute for its secondary an r.f. choke with sufficient inductance to be effective at the intermediate frequency of your receiver. Connect a shielded probe in series with a blocking capacitor to the transistor base end of the r.f. choke. These receivers have surprising gain and in measuring at substantial levels, tracing audio, or to avoid loading a circuit it would be advisable to add a series resistor to the probe. I expected the front transistor to perish from careless exposure to voltage peaks, but a year later it's still able and willing.

. . . W7IDF

A Reader Looks at the Hallicrafter's SR-160

Larry Hess W8GTT/K1ENX
45 Chandler Avenue
Walpole, Mass.

The introduction of the compact SSB transceiver has created great interest in the amateur ranks and, notwithstanding, in my own station where a 1955 vintage receiver was not the ultimate for SSB operation.

My interest increased when Hallicrafters announced the SR-150 transceiver with Receiver Incremental Tuning. This eliminated the one problem in transciever operation, namely having the transmitter frequency shift whenever slight corrections were made in the receiver frequency, such as often occurs in round tables.

When the Hallicrafters SR-160 transceiver was recently introduced, at a price considerably under the SR-150 and included Receiver Incremental Tuning, the decision was made.

The SR-160 provides complete coverage of the 20, 40, and 80 meters bands with 150 watts PEP and 125 watts CW. The Receiver Incremental Tuning (RIT) (pat. pend.) provides a plus or minus 3 kc deviation from the receiver frequency without changing the transmit frequency. Full Automatic Audio Level Control (AALC) provides maximum talk power. No AM provisions are included but satisfactory exalted carrier AM detection results are easily obtained. Push-to-talk (PTT) is standard with VOX as an optional accessory. One meter is used as a combination S-meter and relative output indicator. A 100 kc calibrator circuit is included selected by the Operation switch, but a 12AU6 tube and a 100 kc crystal are not supplied. A matching ac solid state power supply/speaker combination is available as well as a mobile dc power supply.

Functionally, the receiver is a single conversion design with a 5200 kc *if*. The RF amplifier and mixer circuits are tuned by the Driver Tune control on the front panel. Selectivity is provided by a crystal lattice filter and two *if* stages. A product detector and amplified AVC are also employed.

The Receiver Incremental Tuning (RIT) is quite novel in design. A pot applies a variable voltage to a voltage controlled variable capacitance (Varicap) in the frequency determining circuit of the transmit/receive VFO, thereby shifting frequency a small amount. In transmit, this circuit is disconnected by the T/R relay so as to not change the transmitter's frequency. Dial calibration is corrected in a similar manner with a second pot continually in the circuit.

The AALC (Automatic Audio Level Control) provides approximately 15 db of compression when the flat topping point of the two 12DQ6B final amplifiers is reached. When flat topping occurs, a ripple apears on the final amplifier grid bias. This ripple is amplified and rectified by a diode. The resulting dc voltage, which is proportional to the amount of flat topping, is applied to the first *if* amplifier grid as a control bias, thereby reducing its gain and driver output .

Initial installation is quite simple. Power supply, mike, and antenna are connceted and then inserting a voltmeter into two tip jacks on the power supply, the bias voltage is checked and its pot adjusted for the correct value.

Tuneup consists of injecting some carrier through the Carrier control and then peaking the Driver Tune and Final Tune controls for maximum S-meter reading. No loading control is provided as the output network is designed for a 50 ohm load. The Carrier control is then momentarily advanced to obtain a maximum S-meter reading. No carrier balancing is needed.

In push-to-talk operation, the Mike Gain control is adjusted for an S-meter swing equal to one half of the maximum S-meter tuneup value. This adjustment is not critical because of AALC action.

Several notable points were observed in operating the transceiver. The tuning control is very smooth and precise with a good weighted feeling. The receiver sensitivity of 1 microvolt for a 20 db signal-to-noise ratio produces a very low background level with signals almost leaping out of the noise. Tuning is not critical and stability is excellent. The advertised stability is "within 300 cps after warm-up" and operation confirmed this. Banging and dropping the cabinet produced no reaction. Receiver audio is communication quality but not excessively peaked and with plenty of reserve.

On the air tests produced excellent audio reports with no trace of any flat topping, even driving hard, but with plenty of punch. The carrier suppression is -50db down. Mike gain is more than adequate.

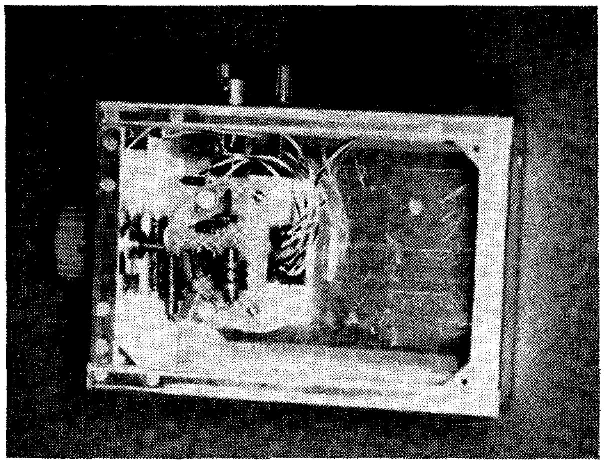
Provisions are provided on the read apron for driving a linear amplifier.

No objections of any kind were found in operating the transceiver. Extra features might be desired but would raise the present $349.95 price.

Hallicrafters has entered the medium price transceiver market effectively with a very pleasing piece of equipment, and demand should soon confirm this.

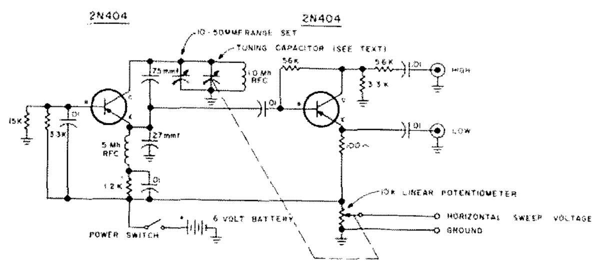
. . . W8GTT

An Armstrong Sweeper



Sometime ago while experimenting with SSB crystal filters at 480 kc, it occurred to me that a manually swept Armstrong oscillator with a pot coupled to the tuning capacitor for 'scope sweep voltage would save point by point frequency measurements with a BC221 while adjusting the filter for minimum in-band ripple. A circuit was hurriedly developed, and the results were even better than expected. Simple though it may be, I'm sure anyone who is working with crystal filters will appreciate its usefulness. The effects of tuning and "diddling" were immediately visible in the in-band ripple and the skirts down to about 20 db could be observed with a few twists of the knob.

With this encouraging experience, a sturdier



Parts Kit Available

Al Donkin W2EMF

model was constructed. The circuit was assembled on a small piece of Vector-board, with the tuning capacitor and batteries mounted in a $5 \times 7 \times 3''$ aluminum chassis. An aluminum bracket was bent to hold the "sweep" pot and mounted behind the tuning capacitor, spaced to accomodate the mechanical shaft coupling. The Vectorboard was also mounted on the bracket.

The oscillator circuit is simple, using a 1 mh rfc for the tank inductor. The range of the circuit as shown is about 400 kc to 500 kc, at center frequency. The tuning capacitor is a Hammerlund MC-50-M with two of the rotor plates removed, resulting in a range of approximately 7-25 mmfd. An untuned amplifier provides isolation of the oscillator from the reactance of the load. I used 2N404 transistors but most PNP *if* transistors will work.

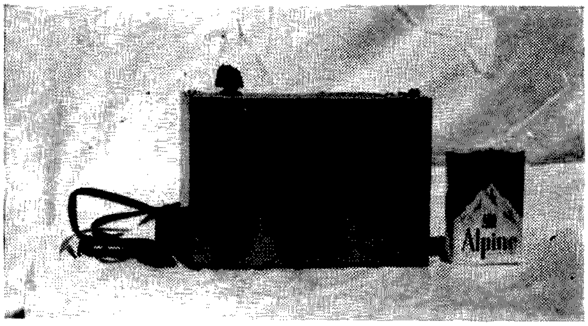
In addition to sweeping crystal filters, I have found this little box handy as a general purpose low frequency oscillator and sweeper for receiver *if*s. The persistency of most oscilloscopes produces a much better display than might be expected, and it certainly beats the point by point method of plotting filter responses. Now I only wish I had a logarithmic amplifier for my scope, so I could look 40 or 50 db down those filter curves. (If the filters were that good!)

. . . W2EMF

Parts Kit Available

This sweep generator solves most of your if and crystal frequency problems. Operates on center frequency 455 kc.

Complete kit W2EMF-1 . . . . $11.95



Pete Crystal WA6OHD
691 Serenade Way
San Jose 11, Calif.

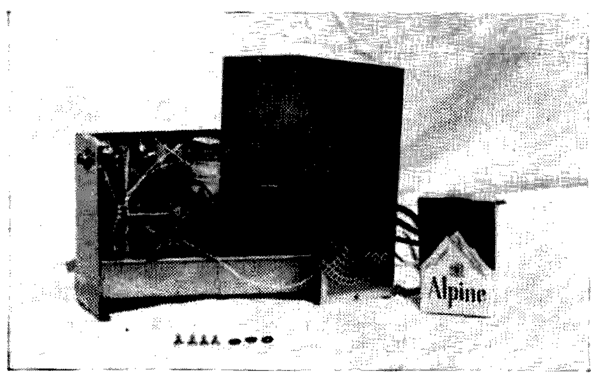
Photos by WA6JWJ

The Mon-Key

Parts kit available

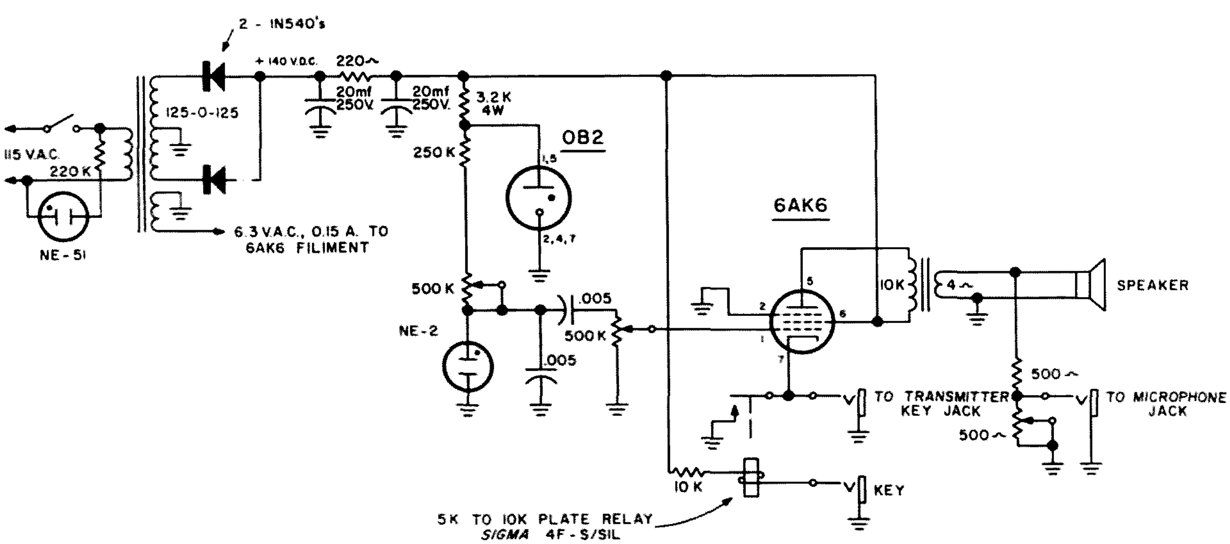
With the mounting interest of MCW on the VHF bands, my Dad, WA6CNL, has built the mon-key. The mon-key is an audio oscillator for monitoring, an audio source for the modulator and a relay for keying the transmitter.

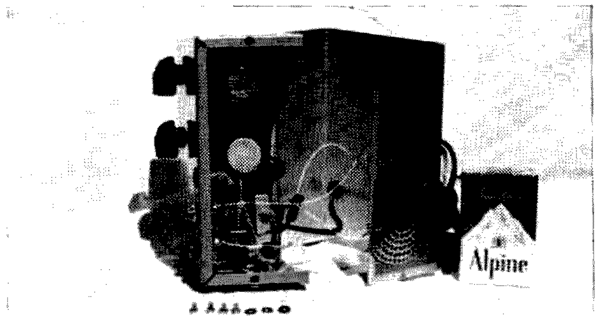
One of the problems of MCW is having a microphone right in front of a CPO which is always a temptation for the operator to talk



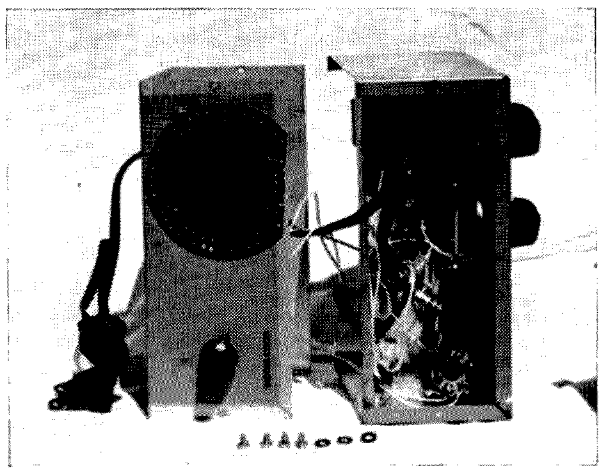
into. It's also distracting for the receiving end to hear coughs, chairs dragging, or dogs barking in the background. We eliminated this problem by feeding the output of the mon-key into the input of the modulator. Another advantage of the mon-keg is that you can key the audio and the carrier. This method has been used for many years by the military as a QRN puncher and it does just that. If you're not interested in A2, this oscillator makes a great CW monitor. It'll work on any type of keyingand speeds, depending on the relay used.

This whole unit was built in a 5" × 7" × 3" box. A two inch speaker scrounged out of a transistor radio was mounted at the top of the box. The relay we used was a Potter Bromfield KCP11, but virtually any relay will work depending on the speed desired. The circuit used is a relaxation oscillator. The voltage for it should be regulated or the oscillator will





shift. The tone from the speaker will not sound real crisp due to the absence of harmonics. Although the audio doesn't sound too crisp through the speaker, it will sound real clear on the air. After everything is wired in, adjust R5 and R6 for the proper tone and audio level. Then with the mon-key connected to the modulator, adjust R8 until you get 100 or near 100 per cent modulation. Do not adjust R6 after you adjust R8 or you will have to readjust R8 all over again.



We have had great success with the mon-key. We have been able to poke a hole through severe QRM and still maintain intelligent communications. The mon-key gives a more CW type of effect and would be beneficial for the tech or novice that can't go on CW, due to the lack of receiving provisions, but wants to go on CW to get more practice.

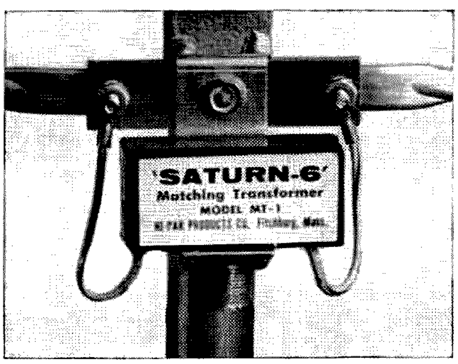
. . . WA6OHD

Parts Kit Available

Complete kit with power supply and speaker. WA60HD-1 . . . . $19.95

New Products

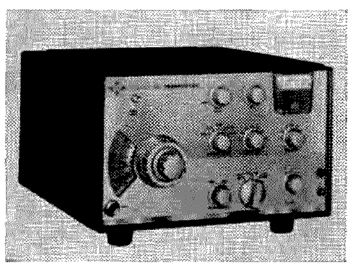
Halo Xformer



Hi-Par now has a new matching transformer for the Saturn 6 antenna. It improves the band-width, simplifies the feeding system, lowers the SWR and costs $4.95.

Crystal Catalog

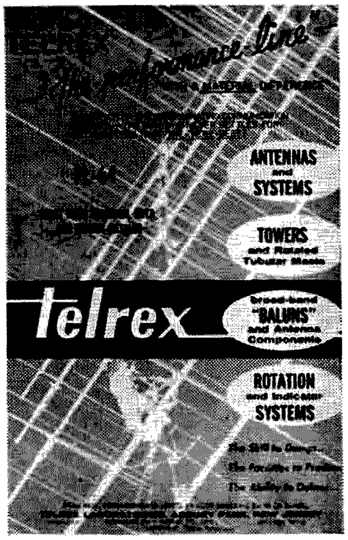
Texas Crystals, 1000 Crystal Drive, Fort Myers, Florida have a new 12 page crystal directory for Citizens Band crystals. You can find what crystal to use for any channel for any make equipment, transmitting and receiving.



Galaxy III

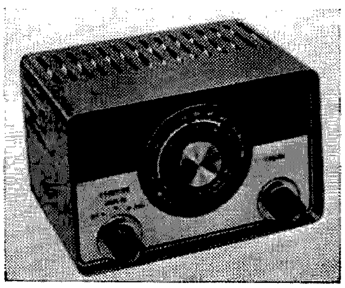
WRL has changed their name to Galaxy Electronics and their newest product is the Galaxy III, successor to the Galaxy 300, a 300 watt (PEP)/SSB/CW transceiver for 80, 40 and 20 meters. The hybrid transistorized circuit permits the small size of 6 v 10¼ x 11¼ which is fine for both home and mobile use and a weight of only 14 pounds. It has a full 500 kc coverage on all three bands, upper or lower sideband. Price is only $349.95. Available accessories are ac and dc supplies, remote VFO, speaker console and a DeLuxe Accessory Console complete with 24 hour clock, speaker, SWR bridge and hybrid phone patch. Write Galaxy Electronics, 10 South 34th Street, Council Bluffs, Iowa for more info.

New Products



Telrex's New Catalog

Telrex has one of the most complete selections of beams going . . . well constructed, reasonably priced. You should have their catalog at hand. Drop note to Telrex, Asbury Park, N. J.



6 and 2 Meter VFO

Lafayette Radio Electronics Corporation, 111 Jericho Turnpike, Syosset, L. I., N. Y. announces a new self-powered Variable Frequency Oscillator for the 6 and 2 Meter Amateur Bands. Model HE-89. Price 29.95

A high quality variable Frequency oscillator designed to operate with modern transmitters using crystal ocsillators in the 8-9 MC region. High electrical stability is achieved by a series-regulator tube protects unit from line voltage variations. Illuminated plexiglass dial is calibrated from 50-54 MC (6M) and 144-148 MC (2M). Output voltage is 10-20 V rms. Tubes 6BA6, OB2 plus low heart half-wave silicon rectifier. Complete 24" low loss coaxial cable. Operates on 117 volts 50/60 cycles AC. Dimensions, 6¼W x 4½H x 4" deep.

Miniature Antennas

Mini-Products has a new catalog available which gives data on 13 different miniature antennas. These are designed for restricted area and mobile applications. Mobile antennas are available for 6 & 10, 6 & 15, 6 & 20, etc. The most ambitious model is a two element beam with elements only 11 feet long that will work on 6-10-15-20 meters. The catalog includes an engineering report on the principle used and gives full info on all models. Mini-Products, 1001 West 18th Street, Erie, Pennsylvania.

EZ-Etch

One of the best ideas we've seen yet for printed circuits. Frankly you have lost your spirit of adventure if you don't send for one of these kits. EZ has taken the misery out of circuit boards by coming up with a scheme which eliminates the drawing and photography. Write Ami-Tron Associates, 12033 Otsego Street, North Hollywood, California. Kit is only $5.95!

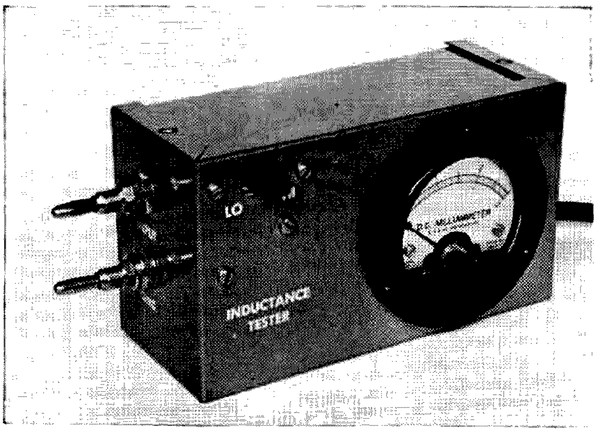
An IF Spotter

Howard Burgess W5WGF
1801 Dorothy St. N.E.
Albuquerque, N. M.

If you have ever tried to find the *if* frequencies of unfamiliar and inoperative pieces of surplus gear with no schematic, it is a waste of time to tell you how rough it can be. Even a single *if* transformer from the junk box can be a problem if it has no part number or identification.

Of course in some cases a grid dip meter can be used to find the operating frequency. However, few grid dippers cover the important *if* frequencies below 2 mc. To complicate things, if a dipper is used on a shielded transformer above 2 mc, the resonant frequency of the transformer may be shifted if the shield is removed.

If these problems sound familiar to you, we would like to suggest a little gadget that can help solve them. With just two resistors, two capacitors, and a tube, don't expect it to give a digital read-out to all your questions, but it can put you in the ball park.



The if spotter. The switch for changing the coupling capacitor is at the upper left marked "HI" and "LO." The posts on the end are X1 and X2.

The principle of operation is as simple as the construction. The tuned circuit in question is merely made to oscillate at its resonate frequency. The frequency can then be determined by tuning in its radiated signal on the ham receiver. To set the unknown coil into oscillation requires the use of a simple "two terminal" oscillator. Such an oscillator is shown in the schematic of Fig. 1. When any tuned circuit is connected to the two points marked X, the circuit will oscillate at its resonant frequency.

In this oscillator the twin triode is a tube such as the 12AT7. The section V2 furnishes the necessary feedback and eliminates the need for extra coils or feedback connections.

The construction is simple. The unit could have been built in a larger case with its own power supply and would have become a nice piece of bench equipment. However, due to the few parts required and the small amount of plate power used (3 mils at 90 volts) it was built as an overgrown probe. The power is robbed from another piece of test equipment or the receiver.

As a probe it can be used on the work bench to test individual coils and transformers or it can be held in contact with the various transformers in a receiver.

There is only one point of caution that should be observed in construction. The lead from the grid contact of VI to the XI post should be kept as short and direct as possible with the least capacity to ground. This lead becames part of the oscillating tuned circuit and limits the upper frequency to which the unit will operate.

The coupling capacitor from the grid of VI to the plate of V2 furnishes the feedback required to maintain oscillation. To reduce the loading on the tuned circuit, this capacitor

should be held to the smallest value that will sustain oscillation. Because of the wide range over which this instrument operates, a switch is provided to change values. With the capacitors shown, operation is possible from about 60 mc down to well below 50 kc. The larger value is used at the lower frequencies and is switched in only when required. With coils of medium Q the switching point is around 3 to 5 mc.

The connectors X1 and X2 can be almost any kind of posts. The ones shown on the unit here are banana plugs. These can be used as test points, or alligator clips can be slid over them for use in clipping to coil leads.

The meter shown is a three mil meter and is used to read the total plate current of both halves of the tube. This will indicate when the circuit is oscillating. When the tester is not oscillating the meter will indicate a current of about 1 mil (with 90 plate volts). Under oscillating conditions the meter will rise to as much as 3 mils with a high Q coil. The actual amount of current is not so important as the fact that the upward shift indicates that the coil is not open and is oscillating. A 5 or 10 mil meter will serve the purpose just as well.

As the pictures show, this unit was built in

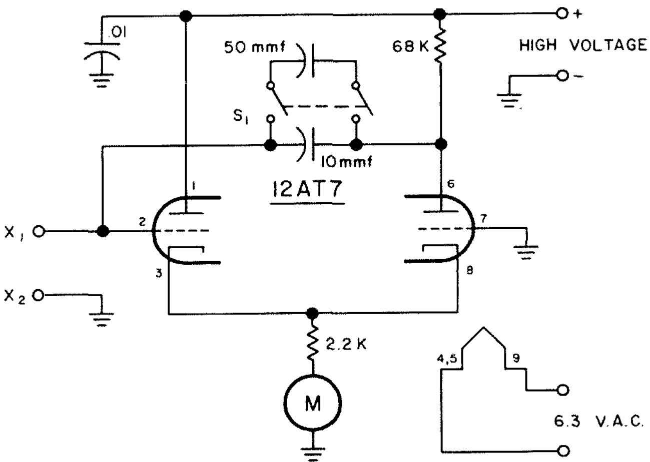
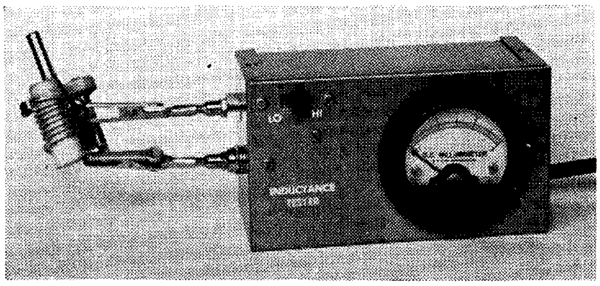


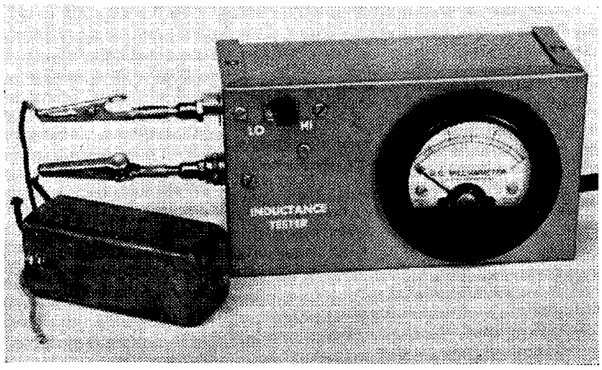
FIGURE I

Circuit diagram of the if spotter

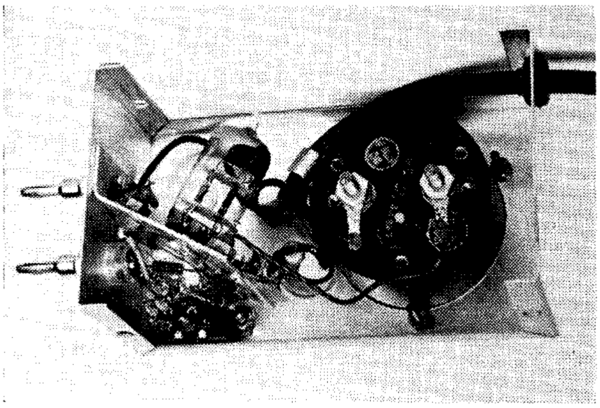
.01 Ceramic capacitor
50 pf Mica capacitor
10 pf Ceramic
68 K ½ watt carbon resistor
22 K ½ watt carbon resistor
Milliammeter in range of 3 to 10 ma
Slide action Double Pole-Single Throw switch (S1)
2 Banana plugs (x1 and x2)
12AT7 tube
Minibox (size depends on type of meter used)
9 pin miniature tube socket



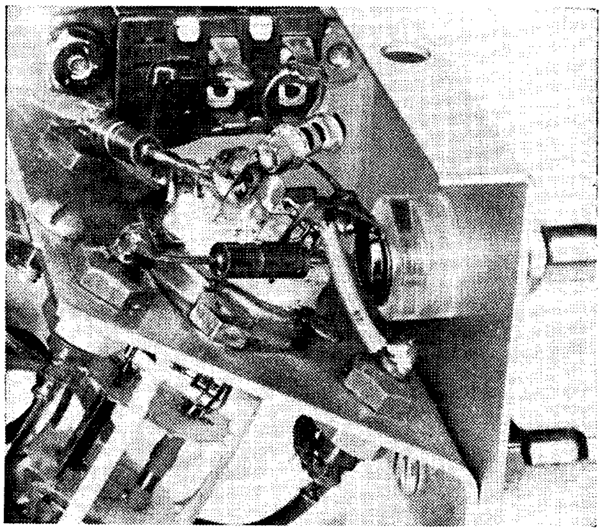
Checking a ten meter tank circuit



Checking an if transformer



Inside view showing extreme simplicity of the "Spotter." The tube is mounted at an angle to keep the grid lead to the "unknown" as short as possible.



Close up of tube socket showing parts placement.

a small 5" x 3" x 2" box. The unit will work just as well if it is built on a small piece of peg board with a couple of leads run out to the multimeter. This is for the man in a hurry.

When the unit is finished, apply power with the "X" points open (no coil across them). Because of the open grid of V1, the meter will drift about. After the tube has had time to warm up, short the X posts with a heavy piece of bus or copper. The meter will now come to rest somewhere around 1 mil. This is the "no oscillation" current and should be kept in mind as a reference point for future use. Now remove the short and connect almost any kind of an LC circuit across the posts. The meter reading will now rise from the "no oscillation" value indicating that the coil is oscillating. Do not use the large coupling capacitor unless the circuit refuses to oscillate with the smaller value.

To check a single *if* transformer, all that is necessary is to hook one of the *tuned* coils to the input terminals of the tester. Be sure that the coil used is not tuned. Some transformers have a number of terminals which may not go directly to the tuned circuit inside. To obtain oscillation there must be both a dc and an rf path between the two posts.

If the transformer is one whose frequency falls in the range below the broadcast band it is quite convenient to have one of the surplus receivers that covers the range down to 200 kc. However the check can still be made with a regular broadcast receiver. All that is necessary is to find the harmonics of the tester as they fall in the broadcast band. They will be separated by a value equal to the frequency of the coil being tested. As an example, if a signal is spotted at 900 kc and the next one higher is found at 135 kc, it is a pretty good bet that the transformer is operating on 450 kc ($1350 - 900 = 450$).

To find the operating frequency of an *if* stage it is not necessary to have the amplifier in operating condition or the tubes hot. Just connect the two contacts across the primary or secondary of the transformer in question and watch for signs of oscillation on the meter. Some transformers have a portion of the bias system inside of the can. This can usually be overcome by connecting the tester from grid to ground of the tube in the stage being tested.

In addition to checking transformers it can also be useful in testing the range over which a transmitter tank will tune. Just make sure that the high voltage is turned off and connect the probe across the tank to be tested. Now you can tune the tank and follow its entire

usable range with the receiver. If the tank being checked happens to be the final, the meter on the probe will indicate when the antenna is brought into resonance.

This little tester was built to do just one thing—sort out some old *ifs* in the junk box. After we tried it we found that it would do a lot of useful chores around the ham shack. With proper care and feeding, it can probably learn to do tricks that we haven't even thought of.

. . . W5WGF

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Oklahoma City, Okla.

The Case of the Naughty Pi-Net

(*Why it misbehaves*)

One of the most popular final-amplifier tank circuits around these days, at all power levels, is the "pi-net"; in the nearly 30 years since it was first introduced to hamdom, it has put almost all other circuits out of the running. One of the main reasons for this is its reputed ability to "match anything," and within limits it fulfills this promise to an amazing degree.

But from time to time one turns naughty, and refuses to behave as billed. Instead of following the book, which says that with the output capacitor (C2 in Fig. 1) set for maximum the loading should be lightest, increasing as the capacitance of C2 decreases, the naughty pi-net either refuses to dip at all, or does so at much too high a plate-current level.

In his excellent roundup of pi-net design data (February, 1962, 73—and required reading for this course) W6JAT had this to say about such a naughty pi-net: "The trouble is probably that the Q is too low. It may be corrected by taking off a turn or two of coil and increasing the input condenser."

But this isn't *always* the trouble; as often as not—particularly in the case of commercially-built rigs which misbehave—the trouble isn't in the pi-net at all. It's in the antenna! With a brief bypass into some supposedly exotic areas of antenna measurement, let's see how it works:

Before getting to the antenna itself, let's take a fast glance at the pi-net and how it works. The handy little circuit is actually an impedance-transforming device, which makes the (hopefully) 50 ohm impedance of your coax look like a high impedance to the final-amplifier tube. When the impedance transformation is what you want it to be, the plate current is automatically what you want also. This is why most of us never meet up with the impedance idea at all—the plate current or "loading level" takes care of it for us.

But for the impedance transformation to take place properly, the pi-net must be terminated by pure resistance on each end. No reactance at all is permissible. In practice, any reactance which *does* show up is tuned out by adjustment of CI and C2. For instance, if your feedline happens to look like 50 ohms resistance together with a capacative component equal to 10 mmfd at operating frequency, you just set the loading capacitor (C2) to 10 mmfd *less* than you normally would. The 10 mmfd contributed by the line makes up the difference. Again, it happens automatically when you adjust controls for proper dip and plate current.

That last paragraph is important, because it contains the full key to why some pi-nets turn naughty. When you have the idea down pat, proceed into the mud of antenna measurements.

Most of us have made the acquaintance of SWR before, but maybe not all of us have seen "Smith charts." These charts are rather complicated-looking graphs used by antenna engineers to simplify some of their measurement techniques, and Fig. 2 is a part of a

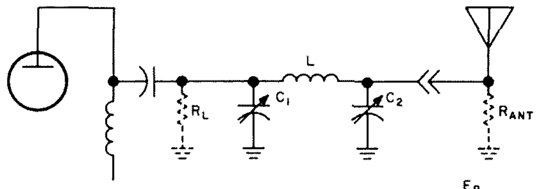


FIGURE I

Basic pi-net circuit, identifying parts designations used in examples throughout text. For data on pi-net design, see W6JAT article, February, 1962, issue of 73, or standard radio handbooks.

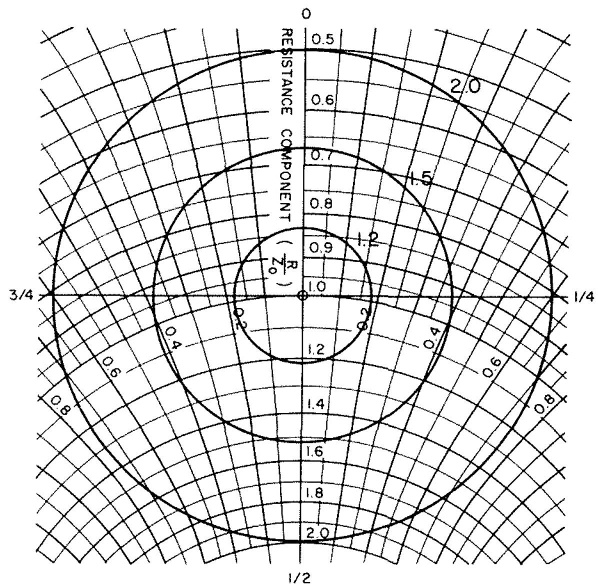
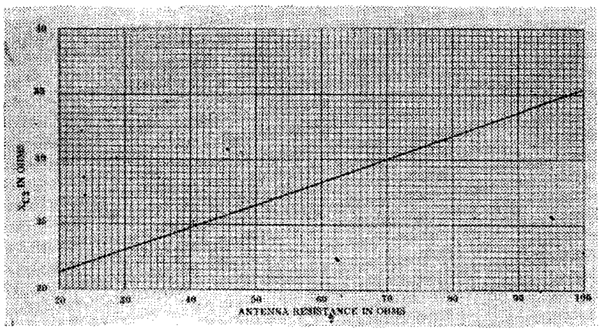


FIGURE 2

Portion of Smith Chart showing resistive and reactive components of coax impedance at transmitter end of line, for all possible line lengths. Figures at edges of graph represent wavelengths of line; all even wavelengths may be ignored since impedance repeats itself every full wavelength and thus only fractions of the last wavelength are important. See text for details of remainder of chart and how to read it.

Smith chart drawn for SWR values of 1.2, 1.5, and 2.0. All these SWR readings are within the limits usually considered acceptable for ham work.

Here's what this Smith chart shows: The concentric circles represent all the possible values of impedance which the coax can present to the transmitter regardless of its length. The scale labelled "resistance component" shows the resistance presented by the coax (after you multiply by 50, which is the resistance for an SWR of 1.0). The other scales composed of arcs coming in from the sides shows the reactive components of the coax input impedance; those to the right of the resistance scale are capacative reactance while those to the left are inductive; again, the



Reactance of C2 in ohms required to match various antenna resistance values between 20 and 100 ohms; antenna is assumed to be pure resistance.

values on the chart must be multiplied by 50 to come up with the true applicable values in this case.

To make it simpler, here's an example. If the SWR is 2, the coax can look like 25 ohms (0.5 times 50) pure resistance at a voltage null, or like 100 ohms (2.0 times 50) at a voltage peak. In between, it can be 40 ohms resistance plus 30 ohms capacative reactance (read at the intersection of the horizontal line and the 2.0 SWR circle) or 40 ohms resistance plus 30 ohms inductive reactance. It can also be 30 ohms resistive plus 15 ohms capacative (at the point marked X), or anything else on the 2.0 SWR circle.

One complete trip around the circle represents one full wavelength of coax between transmitter and antenna. If the antenna is taken to be the starting point, and we start at the top (the 25 ohm point on the 2.0 SWR circle) then the intersection of the circle and the right-hand horizontal line will mark ¼ wavelength, the intersection with the lower vertical line will mark ½ wavelength, and that with the left-hand horizontal line will mark ¾ wavelength. As we keep on going, we find that the values are the same at ¼ and 1¼ wavelength, etc.

All of which may seem as clear as the inside of a strawberry pie but not very relevant to the case of the naughty pi-net. However, things are about to begin falling into place.

Let's go back to the pi-net itself and find out what happens to the adjustments of C2 as the antenna resistance varies: we'll ignore all other adjustments for now, and we won't think about tuning out any reactance either.

Fig. 3 shows the results of some rather lengthy calculations which we won't go into here in detail; the procedure for obtaining these values is spelled out step-by-step in the 1957 ARRL handbook but has been omitted in later editions; W6JAT's article also gives the equation for this calculation.

The values shown in Fig. 3 were calculated for a single 6146 operating with 600 volts on the plate and 120 ma plate current, which is equal to a 2500 ohm load impedance. They'll hold true for any tube and set of operating conditions which amounts to a 2500 ohm load impedance, as well—but the important thing here is not the exact figures, but what happens to them as the antenna resistance changes.

For instance, with an antenna resistance of 50 ohms (design value) the reactance of C2 should be 26.5 ohms. This comes out to be 860 mmfd at 7 mc. When antenna resistance drops to 25 ohms, C2's required reactance drops to 22.2 ohms, or 1040 mmfd at 7 mc. With antenna resistance of 100 ohms, C2 must show 35.3 ohms, which is 642 mmfd at 7 mc. All of these values are within the range of a 3-section 365 mmfd BC capacitor, the kind so widely used for loading control, but the 1040 mmfd requirement means that the loading will be nearly at zero when proper loading is actually achieved!

Now let's go back to the Smith chart in Fig. 2 and see what the coax looks like when there's some SWR on the line. If we tried to make a table showing every possible length of coax we would run out of space in a hurry, so we'll show only the quarter-wavelength-aparts points. And since all the even wavelengths can be subtracted without changing things, this means we need only show the 0, ¼, ½, and ¾ wavelength positions along the line. The table appears in Fig. 4.

In Fig. 4, the first figure in each of the impedance entries is pure resistance, while the second is reactance (which must be tuned out by our pi-net). Following the normal convention, capacative reactance is shown as nega-

LINE LENGTH SWR Value	0	1/4	1/2	3/4
1.0	50± 0	50± 0	50± 0	50± 0
1.2	60± 0	49+ 9	41± 0	48- 9
1.5	75± 0	42+19	33± 0	42-19
2.0	100± 0	40+30	25± 0	40-30

FIGURE 4. Input impedance of coax as function of line length and SWR on feedline. See text for details.

LINE LENGTH SWR Value	0	1/4	1/2	3/4
1.0	-26.5	-26.5	-26.5	-26.5
1.2	-28.4	-35.2	-24.8	-17.2
1.5	-31.1	-44.0	-23.7	- 6.0
2.0	-35.3	-54.7	-22.2	+ 5.3

FIGURE 5. Reactance in ohms of C2 for example cited in text with variations in SWR and in length of feedline; reactive component of coax input impedance is ignored.

tive while inductive becomes positive.

You can see that with an SWR of 1.0, the impedance looking into the coax is 50 ± 0 regardless of line length. You knew this anyway.

But with an SWR of just 1.2, the impedance varies from 60 ± 0 at the 0-wavelength position through 48 − 9 at ¼ wavelength back to 41½ ± 0 at ½ wevelength, then through 48 + 9 at the ¾-wavelength point before returning to 60 ± 0.

This, of course, means that now our pi-net has to cancel out the reactance as well as matching the resistances. To find out where C2 should be set to accomplish this, let's subtract the reactance values in Fig. 4 from those given in Fig. 3 for the corresponding resistance values. Reactance values in Fig. 3 are all negative numbers, by the way. The result of all this arithmetic appears in Fig. 5, which gives the capacative reactance required in C2 to match the line at the various line lengths and SWR values we've been talking about.

All looks pretty cozy in Fig. 5, with one exception. Remember that negative reactance values are capacative, while positive values are inductive. Now look again at the reactance of C2 for a ¾-wavelength line with 2.0 SWR. How are we ever going to make C2 look like 5.3 ohms of inductance???

LINE LENGTH	0	1/4	1/2	3/4
SWR Value				
1.0	860	860	860	860
1.2	800	645	915	1320
1.5	730	516	958	3790
2.0	642	415	1040	***

FIGURE 6. Value of C2 in micromicrofarads at 7 megacycles for example in text; *** notes that no value of capacitance will satisfy the requirements—0.1225 microhenries of inductance are necessary in this case.

The answer, of course, is that we can't. The pi-net is being naughty. But as you have seen it's not the pi-net's fault at all.

And we're not through yet. Let's move on to Fig. 6, which presents the same thing as Fig. 5 except that now instead of ohms of reactance we're talking in terms of mmfd of capacitance, figured at 7 mc.

With a 1-to-1 SWR, all is well, and the pi-net will behave as billed. Ignoring the ¾-wavelength point, the pi-net w'll still load more or less with higher values of SWR, but the loading controls will be far from the book-stated positions. At ½ wavelength with 2.0 SWR, particularly, proper loading will happen at nearly full capacitance of C2.

LINE / SWR	0	1/4	1/2	3/4
1.0	79	79	79	79
1.2	73	59	84	(1)
1.5	67	47	88	(2)
2.0	59	38	95	(3)

Notes: (1) Maximum C not enough
(2) Max C not near enough
(3) Impossible with Cap.

FIGURE 7. Setting of loading control in percentage of rotation, for example discussed in text. Note wide deviations.

To drive it home still more, move on to Fig. 7 (the last of our little charts). This shows approximate percentage of rotation of the loading capacitor, with 100 percent equal to maximum capacitance. It's figured for our 2500 ohm pi-net, the same as everything else we've talked about, and for 7 mc operation using a 3-gang BC variable for C2.

Now we find that if the coax happens to be ¾ wavelength long, the pi-net won't behave with any appreciable SWR at all. Even a "tiny" 1.2 SWR value will put the setting of C2 out of range of the variable.

And as we've said all the way through, it's not the fault of the pi-net. The trouble is in the antenna and the SWR.

So what can we do? At lower frequencies particularly it's almost impossible to keep SWR down to 1-to-1 over an entire band. In addition, the SWR may not be causing any other troubles at all.

One of the quickest ways to do something about it is to prune the line. This sounds horribly old-fashioned in view of all that's been published in the past few years to the effect that line pruning will not change SWR. It won't change the SWR, true, but it *will* change what the SWR does, most drastically.

Look back at Fig. 7 to see just how much difference a half-wave of line length can make. With SWR of 2.0, it's impossible to load the pi-net at a line length of ¾ wave; the same antenna loads more easily than with a 1.0 SWR at a line length of ¼ wave!

If your coax is too short to prune, get an extra half-wavelength and add it in; this will have the same effect.

If you want to be more scientific about it all you can add an antenna tuner between the transmitter and the feedline to make the SWR seen by your pi-net exactly 1.0. This will not only bring the loading control back to instruction-book settings but will guarantee you additional reduction of harmonics, always a good thing.

But either way, don't always blame the pi-net. Even if it appears at first glance to be naughty, frenquently it's not the culprit.

Case dismissed. . . . K5JKX

60 Watts on 75

Don Mathon VE1IC
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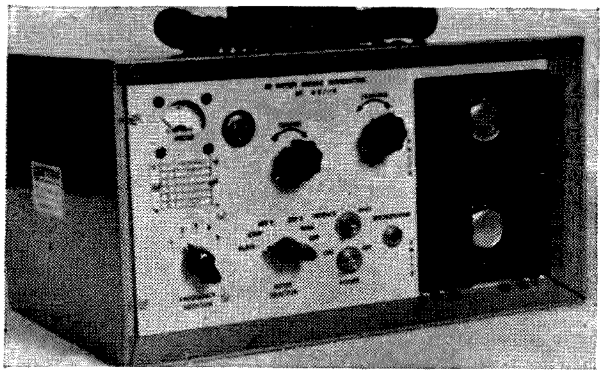
For a long time I had planned building a transmitter which would include as many modern features as possible and which would have an appearance comparable to that of commerical equipment.

The first step in obtaining a commercial appearance was to choose a modern streamlined cabinet for the finished product. Searching through my catalogues, I discovered the Bud "Shadow Cabinet" line which seemed to fill the bill very nicely, so, number SB214D was ordered along with a chassis number AC424 to match.

Now that the cabinet and chassis had been decided upon, the circuit and accompanying features had to be designed. The idea of commercial quality was kept in mind throughthis design phase and for the sake of compactness and modern functional features, the modulator and power supply, both transistorized, were built-in. The schematic diagram seen in figure two is the result of much head scratching, slide rule heating and paper wasting.



Circuit Description

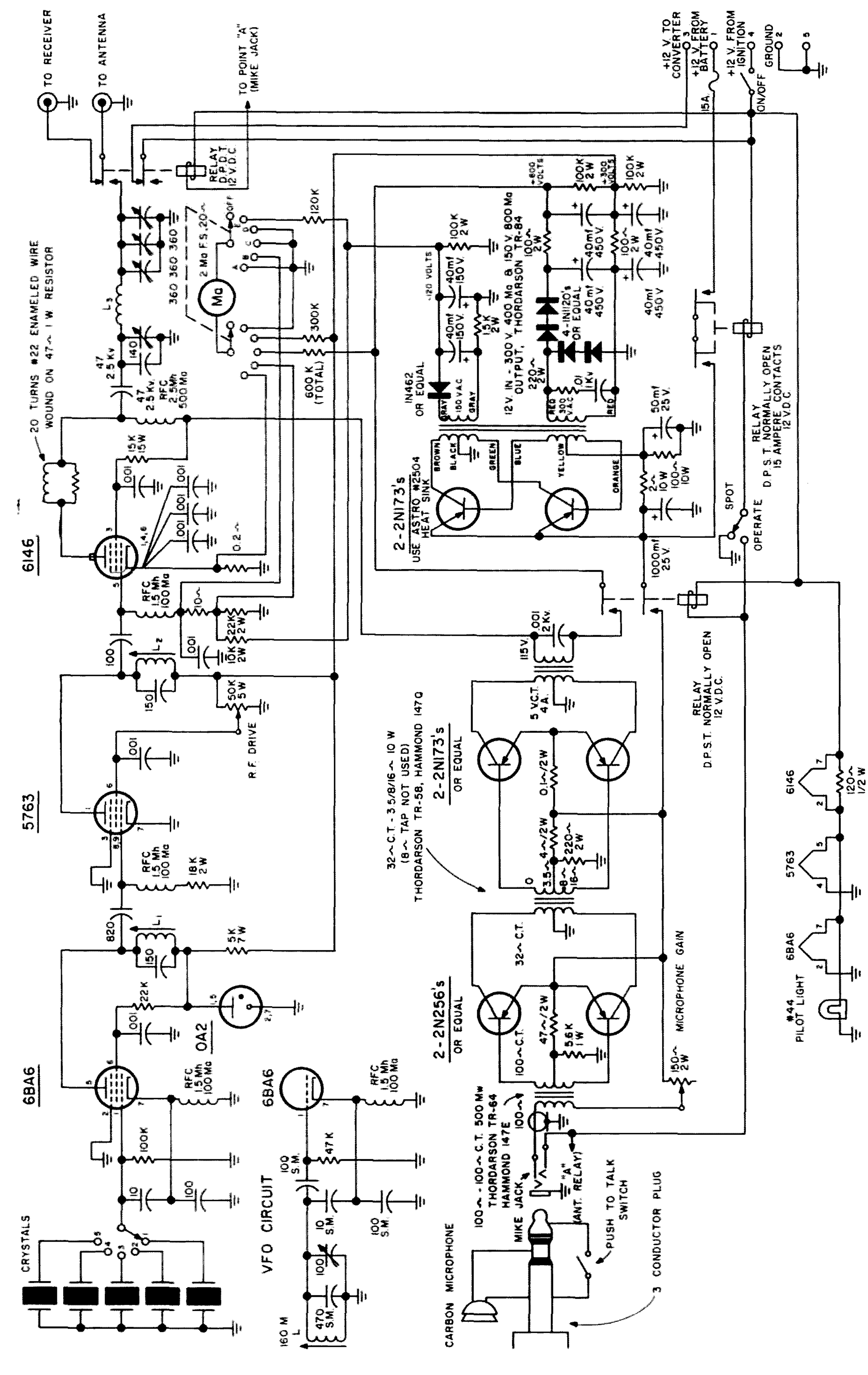
A few words of wisdom, explaining the theoretical operation of the transmitter, is a must in any article, so, here goes.

The rf section, consisting of an oscillator, a buffer/driver, an output tube and a PI network antenna coupling, will be discussed first.

The oscillator is a crystal controlled, modified Pierce type. This particular circuit was chosen and voltage regulation introduced with a view that, if it ever became desirable to operate this stage as a VFO, the changeover would be fairly simple and would not necessitate major changes in wiring. The crystal selector switch allows any one of five channels to be selected (more crystals may be used by having more contacts on the switch). The plate of the 6BA6 is broadly tuned to the center of the most used portion of the 75 meter band. The oscillator is capacitively coupled to the buffer/driver stage.

The rf choke in the grid circuit of the 5763 provides for a more efficient operation. The screen of this stage is connected to the B plus through a 50K 5W potentiometer which allows its voltage to be varied, thus allowing control on the grid current of the 6146. Again the plate of this stage is broadly tuned; the broad tuning in this and the last stage, eliminates two controls which would otherwise be on the front panel. Capacitive coupling is used again between this stage and the 6146.

An rf choke is also found in the grid circuit of the output stage and its purpose is the same as explained above. Extensive by-passing is used around the 6146 socket by connecting capacitors from pins 1, 2, 4, 6, and 7 to ground. This heavy by-passing prevents parasitic oscillation and the radiation of high frequency harmonics which would interfere with television. A certain amount of fixed bias is used on the grid in addition to the excitation bias as a safety measure to protect the 6146 in case of drive failure. This fixed bias also assures better linearity of modulation. The modulation is applied to both the plate and



TO RECEIVER
TO ANTENNA
TO POINT "A" (MIKE JACK)
RELAY D.P.D.T. 12 V.D.C.
20 TURNS #22 ENAMELED WIRE WOUND ON 47~ 1 W RESISTOR
6146
5763
6BA6
0A2
CRYSTALS
VFO CIRCUIT
160 M
2 Ma F.S. 20~
600 K (TOTAL)
R.F. DRIVE
+12 V. TO CONVERTER
+12 V. FROM BATTERY
+12 V. FROM IGNITION
GROUND
ON/OFF
15A.
12 V. IN - 300 V. 400 Ma & 150 V. 800 Ma OUTPUT, THORDARSON TR-84
4-1N1120's OR EQUAL
1N462 OR EQUAL
2-2N173's USE ASTRO #2504 HEAT SINK
RELAY D.P.S.T. NORMALLY OPEN 15 AMPERE CONTACTS 12 V.D.C.
SPOT
OPERATE
RELAY D.P.S.T. NORMALLY OPEN 12 V.D.C.
32~ C.T. - 3.5/8/16~ 10 W (8~ TAP NOT USED) THORDARSON TR-58, HAMMOND 147Q
2-2N173's OR EQUAL
2-2N256's OR EQUAL
MICROPHONE GAIN
100~ - 100~ C.T. 500 Mw THORDARSON TR-64 HAMMOND 147E
MIKE JACK
"A" (ANT. RELAY)
PUSH TO TALK SWITCH
3 CONDUCTOR PLUG
CARBON MICROPHONE
#44 PILOT LIGHT

FIGURE 1

screen of the 6146 also to obtain better quality of audio. The plate of the output stage is coupled to the PI network. This type of output network is used to provide better efficiency and eliminate TVI problems.

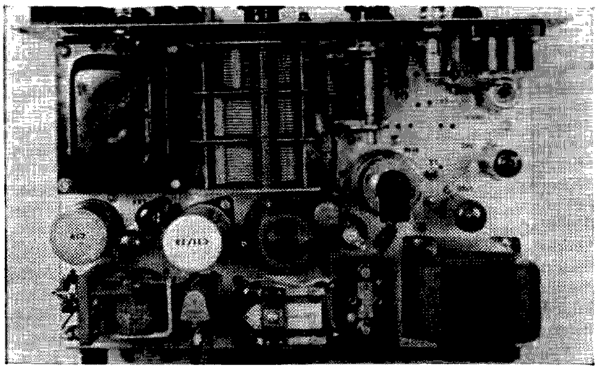
The front panel meter serves a twofold purpose; it is used first as an ammeter to measure the plate and grid current of the 6146 and, second, as a voltmeter to measure the output of the power supply (600V., 300V. and −120V). The shunt and multiplier values were chosen so that, when all voltages and currents are correct, the pointer will rest within a red portion painted at mid-scale on the face of the meter.

The mike gain potentiometer controls the voltage applied on the carbon microphone, thus effectively controlling the amount of audio applied to the bases of the 2N256s. Their collectors drive the bases of the 2N173 modulators and, in turn, the modulators apply the audio to the 6146. Both stages of the modulator use transistors in push-pull biased by resistor networks in such a way that only a very slight amount of current will flow through the transistors when no audio is being applied. This small bias will prevent cross-over distortion from being produced in the audio system. The .1 ohm resistor prevents current run-away of the modulators while the .001 condenser effectively limits the high frequency response of the audio system as well as absorbing any high voltage transients which might be harmful to the modulator transistors.

The power supply is the ordinary run-of-the-mill multivibrator type with feedback being provided by a winding on the transformer. The high voltage secondary makes use of a voltage doubler rectifier circuit so that a 300 volt winding may provide both 600 and 300 volt dc. The −120 volt bias is provided by a separate 150 volt winding which is rectified by a 1N462 silicon diode and filtered. Resistors provide a bias on the base of the power supply transistors which assures instant start when power is applied.

The control circuits are a little unorthodox in their designs; they will prevent operation of any part of the transmitter when the ignition switch of the car is off and they will

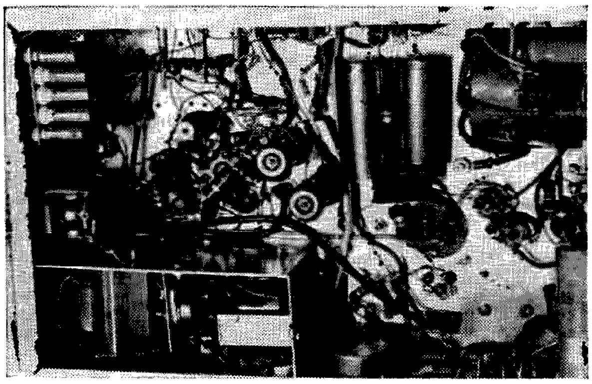
Coil Data, Fig. 1
L, L1, L2: 46 turns #27 enam wire on ¼" dia. slug tuned coil form. Two layers of 23 turns closewound.
L3: 35 turns #18 enam on bakelite 1⅜" form, 1½" long close wound.



Top view. Power transformer lower right, transistors on front panel. Modulation transformer upper left. The two 6X4 rectifiers have been replacd with silicons. Modulator transistors are mounted on rear apron.

allow spotting to be carried out without putting a signal on the air. Plus 12 volts is brought in from the accessory terminal on the ignition switch to pin 4 of the power plug, from there, through the on/off switch, it is used to feed the filaments, the power relay and, through the relay, the transistorized convertor used here in conjunction with the transmitter. Another 12 volt line is brought directly from the car battery to pin 1 of the power connector and from there goes to the contacts of the power relay through a fuse. It can be seen from the diagram that when this relay is energized, it provides power to the other two relays, to the modulator and to the power supply. If the spot/operate switch is in the spot position only the power supply receives 12 volts from the power relay, the modulator is off, the 600V does not reach the 6146 and the antenna and 12 volts dc is still connected to the converter. The oscillator and buffer/driver stages are both on at the same time as the converter, thus allowing spotting.

For those who may want to build the oscillator stage as a VFO rather than crystal controlled, a diagram is included giving all the necessary information and parts values.



Bottom view. Gain control at mid-top, modulator at top right, drive control mid-right.

Construction

When all holes have been punched on the chassis and all components have been mounted in position, the actual wiring is started.

The first part to be wired is the modulator sub-assembly. All components are mounted on the shield/bracket and all connections soldered. When all wiring is done and rechecked on the shield/bracket, it should be mounted in position and the final connections made to the modulator transistors and to the audio gain control.

The filaments and control circuits are wired next. This wiring should be routed along the edges of the chassis and around the modulator shield or, directly in the center of the chassis from front to back.

The power supply section wiring comes next. Care should be taken when connecting the feedback winding of the transformer and the color code of the leads should be observed as per the instructions which come with the transformer. If the feedback winding is reversed the power supply will not operate and it may damage the transistors.

The rf section is the last to be wired. All wires in this section should be kept as short and as direct as possible and, to this effect, extensive use is made of terminal strips and ground lugs. The bracket holding the crystal sockets is the last component to be mounted and for easier access, all wires from the crystal switch to the crystal sockets are soldered before the bracket is mounted to the chassis.

The heat sink for the two modulator transistors is made from a small piece of 16 gauge copper. The base of the sink is bent in a U shape. The fins, which are also bent in a U shape, are soldered in position and then the holes for mounting the transistors are drilled. The heat sinks for the power supply transistors are purchased commercially because they have to dissipate considerably more heat and also look better on the front panel. The shield/bracket for the modulator is made from 16 gauge aluminum bent in J shape with ⅜" lips bent outwardly from the shield at the bottom and at both ends. This shield measures 5⅝" long by 2½" wide by 2¾" high. Transistors Q1 and Q2 are mounted on a small piece of 16 gauge aluminum fastened to the center of the shield/bracket.

Testing and Alignment

Connect rig to 12 volts and check filaments. With the spot/operate switch in the spot position when the microphone push-to-talk switch

is depressed the power supply should start operating immediately and a high pitch hum should be heard.

Make a voltage check with a VTVM or VOM at the output of the power supply (600V, 300V and −120V). The voltages should also check on the front panel meter.

Adjust the slug of coil L1 for maximum grid bias on the 5763. The slug of coil L2 is then adjusted also for maximum bias on the 6146 and the drive control is advanced slowly until the grid current of the 6146 reaches 3 ma as indicated on the front panel meter. A VTVM is necessary for the measurements of grid bias to provide an accurate adjustment of L1 and L2.

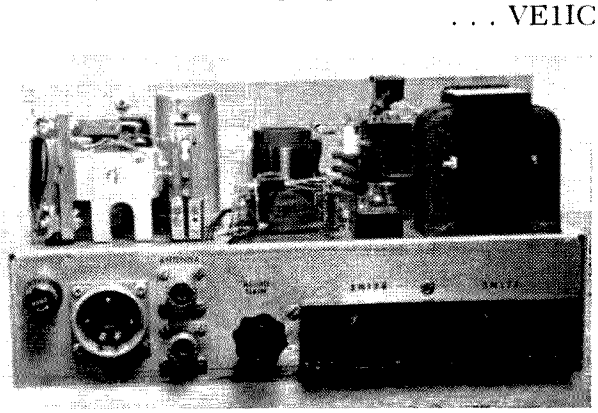
Place the spot/operate switch to the operate position, connect a dummy load (60 watts light bulb) to the antenna jack. Depress the PTT switch and proceed loading the 6146 in the usual manner. The light bulb should glow near normal brilliance when the plate current reaches approximately 100 ma on the front panel meter. The drive control is then readjusted for a reading of 3 ma.

Press the PTT switch and, while speaking into the microphone, advance the gain control slowly until the brilliance of the light bulb in the output varies with audio peaks. The modulation quality may then be checked by listening to the shack receiver with a pair of earphones.

Conclusions

The results obtained with this little jewel are amazing. On the night it was completed, using a piece of wire some 15 feet long (most of it was lying on the basement floor) as an antenna, I got a 5 by 7 report from a station 150 miles away when all I was looking for was a report from a local station on my audio. When connected in the car to the whip antenna, the results were also excellent and lived up to my most exacting expectations.

. . . VE1IC



Push Button Control

Dale Cockle K5JIC/1
50 Barrett Street
Needham 92, Mass.

How would you like your transmitter control circuitry to be controlled by a single pushbutton? Push the button and, presto, B plus, plus it again, and back to standby. How would you like your transmitter control circuitry to automatically prevent reapplication of B plus through those cold mercury vapor rectifier tubes upon resumption of power after a power failure or blown fuse? How would you like this same circuitry to mute the receiver and switch the antenna relay automatically just before the B plus is applied to the transmitter, and to reactivate the receiver and release the antenna relay after the B plus is removed from the transmitter? I reiterate, all controlled by a single pushbutton; push it once to go from receive condition to transmit condition, and push it again to return to receive condition. All this is just one of many applications of the sequential switching circuit whose discussion follows.

First, let's completely discuss the circuit and its output options in general terms in order to give the experimenters the whole story to enable them to dream up their own applications, and for general edification.

Fig. 1a. is a functional diagram of the circuit. The capacitor looking double parallel lines indicate normally open contacts, and the single lines are normally closed contacts. The identifying letters indicate on which switch or relay the contacts are "built" (the prime notation on an identifying letter also indicates normally closed contacts). In this circuit the S and S' indicate contacts on the pushbutton, the R_1 and R_1' indicate contacts on Ry1, and R_2 indicates contacts on Ry 2. Fig. 1b. is the schematic representation of the same circuit. Fig. 1 indicates no contacts associated with controlling the load's power loop. These contacts merit special mention which is made further along in the article.

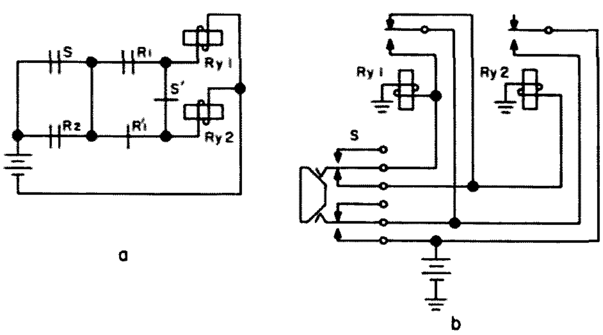


FIGURE 1

A study of chart 1 tells us what happens in Fig. 1 as we operate and release S. Each condition has been assigned a step number to which future references will be made.

CHART 1

Step #	S Operated	S Released	Ry 1 Operated	Ry 1 Released	Ry 2 Operated	Ry 2 Released
1		X		X		X
2	X			X	X	
3		X	X		X	
4	X		X			X
5		X		X		X

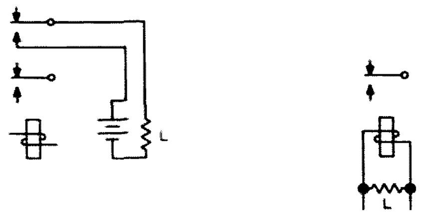
Step 1 is the off condition (and the initial condition taken upon availability of power to operate the circuit).

Step 2 occurs when S is depressed during a step 1 period. Ry 2 becomes activated during step 2.

Step 3 occurs when S is released during a step 2 period. Ry 1 operates during step 3.

Step 4 occurs when S is depressed during a step 3 period. Ry 2 releases during step 4.

Step 5 occurs when S is released during a step 4 period. Ry 1 releases during step 5. Actually steps 1 and 5 are identical if we say that step one is the condition achieved upon availability of power to operate the circuit or condition achieved upon release of S during a step 4 period.



Ry 2 For Step 2 & 3 ON
Ry 1 For Step 3 & 4 ON
a

Ry 2 For Step 2 & 3 ON
Ry 1 For Step 3 & 4 ON
b

FIGURE 2

Now we can talk about controlling power to a load. There are seven possibilities with respect to ON periods assuming that steps 1 and 5 are OFF periods. The seven possibilities are:

1) Steps 2 and 3
2) Steps 3 and 4
3) Steps 2, 3 and 4
4) Step 3
5) Step 2
6) Step 4
7) Steps 2 and 4

Below is discussed each of the seven possibilities in order of simplicity. Although some of the possibilities may not seem important to most of us, they merit mention at least to mention the versatility of such circuits and to furnish more food for thought to the homebrewers and tinkerers who follow this publication for new ideas.

The simplest outputs to achieve occur during steps 2 and 3 and during steps 3 and 4. Chart 1 tells us that Ry 2 is operated during steps 2 and 3, and Ry 1 is operated during steps 3 and 4. Simply by using a set of normally open contacts on Ry 2 or Ry 1 in series with the load's power loop, the load can be turned on during steps 2 and 3 or during steps 3 and 4 respectively (see Fig. 2a). As an alternative, if the switching circuit's switch, relay contacts, and associated wiring can handle the load's power requirements, power for the load may be taken from across the relay winding (s) (see Fig. 2b.).

To attain outputs during steps 2, 3 and 4 we must, as the logic circuit engineers would say, "OR" Ry 1 and Ry 2. This means that we attain an output if Ry 1 and/or Ry 2 is operated. To accomplish this we need a set of normally open contacts on Ry 1 and Ry 2 connected in parallel. This contact arrangement, in series with the load's power loop, will turn the load ON during steps 2, 3 and 4 (see Fig. 3).

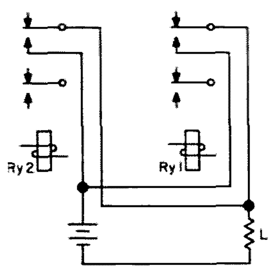
If we desire an output only during step 3 we must, as the logic term "AND" implies, place a set of normally open contacts on Ry 1 *and* Ry 2 in series. This combination of contacts, in series with the load's power loop will result in the load being ON only during step 3 (see Fig. 4).

For output only during step 2, or only during step 4, requires a normally closed set of contacts on one relay in series with a normally open set of contacts on the other relay, this combination in series with the load's power loop. To attain output only during step 2, the normally open contacts are on Ry 2 and the normally closed contacts are on Ry 1. The converse holds for output only during step 4 (see Fig. 5).

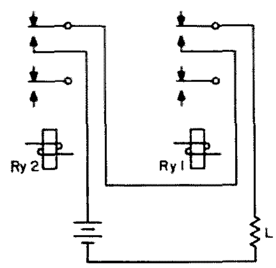
To attain output only during steps 2 and 4 is the most complex of the seven possibilities. A transfer set, commonly called double throw contacts, is required on each relay. The normally OFF sides of each are connected to the normally ON sides of the other. The common contacts of each are the two terminals used in putting this contact combination in series with the load's power loop (see Fig. 6).

Naturally, more than one of the seven possibilities can be "built up" on the two relays. The transmitter control example at the beginning of this article is a case where we want the B plus ON during step 3, and the antenna relay operated and receiver muted during steps 2, 3 and 4.

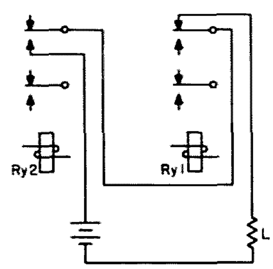
If you cannot come up with a pushbutton from your junkbox with the necessary contact arrangement, you may use a relay with the necessary contacts in lieu of the pushbutton (S) and use a simple doorbell type pushbutton to operate the relay. This configuration also permits control from more than one location by putting additional pushbuttons in parallel



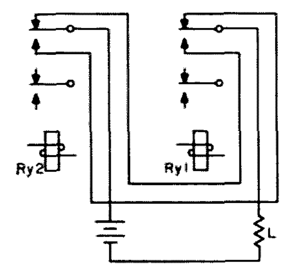
For Steps 2, 3 & 4 ON
FIGURE 3



For Step 3 ON
FIGURE 4



For Step 2 ON
(Reverse Ry 2 And Ry 1 Contacts In Load Loop For Step 4 ON.)
FIGURE 5



For Steps 2 & 4 ON

FIGURE 6

with the first (or the push-to-talk control on the transmitter mike that wouldn't have to be held down during the transmission).

At this point you may be asking yourself, "Why doesn't that guy go out and buy a multi-position relay?" Well, I do the most with what's in my junkbox before spending a cent.

A word of caution: make sure that the contacts on the switch and relay contacts can carry the current and have necessary insulation from adjacent contacts in your application of any sequential switching circuit.

There it is fellows, a sequential switching circuit that has many uses around the shack. Have fun with it and let our honorable editor or me know if you want some more info on more complex (and more versatile) sequential switching circuits. One I'd like to do for this publication is "Dial-A-Tenna"; using a telephone dial mechanism to select an antenna. How about it?

Armed Forces Day: May 16

Here's your once a year opportunity to get a QSL from a non-ham station and to get a certificate for copying a message at 25 wpm. An RTTY message will be sent too for the RTTY gang. General contacts will be made from WAR/NSS/AIR in D. C. from 161400 to 170245 GMT. NPG in San Francisco from 161800 to 170800 GMT. WAR: 4001.5 CW, 4020 AM, 6992.5 CW, 7325 CW to phone, 14405 SSB. NSS: 3365 CW (working 3.5-3.65 mc), 4015 CW (working 3.65-3.8 mc), 6970 CW (working 7.0-7.1 mc), 7301 CW (working 7.1-7.2 mc), 4040 AM (working 75 & 40M), 14385 SSB, 4012.5 RTTY, 7380 RTTY, 14480 RTTY. NPG: 3357 CW (working 3.5-3.65 mc), 4005 CW (working 3.65-3.8 mc), 6835 CW (working 7.0-7.1 mc), 7301.5 CW (working 7.1-7.2 mc), 13920 CW, 4045 AM, 13975.5 SSB, 4001.5 RTTY, 7375 RTTY, AIR: 3397.5 CW, 6997.5 CW, 13995 CW, 20994 CW, 7305 SSB, 14397 SSB, 7332 RTTY.

The CW receiving contest is at 170300 GMT. WAR/NSS/AIR on 3347, 3385, 4015, 5200, 6970, 6992.5, 7301, 7680, 13995, 14405. A6USA San Francisco on 6997.5. NPG San Francisco on 4005, 7301.5, 13920. AG6AA California on 7832.5.

The RTTY receiving contest is at 170335 GMT. WAR/NSS/AIR on 14480, 3347, 4012.5, 6992.5, 7305, 7380, 14405. A5USA in Texas on 4025. AG4AA in Texas on 4455. A6USA in Calif. on 6997.5. A6GAA in Calif. on 7832.5 NPG in Calif. on 4001.5, 7455, 13895.

Send all logs as received to: Room 5B960, Pentagon, Wash., D. C. Include time, frequency, call sign of station copied, your name, call, and address on page containing text.

Waveguide Simplified

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With the present emphasis on UHF, the region of the future, many of us are scratching our heads in wonder at the strange types of circuit components we'll have to deal with. Not the least perplexing by any means is waveguide, the UHF man's answer to cable losses. How the dickens can a hollow pipe carry rf anywhere?

Few of the available reference books prove to be of any help, either, unless you happen to be an electrical engineer well versed in the solution of partial differential equations and highly familiar with Maxwell's equations—and in that case, you wouldn't have been asking anyway. Which leaves the rest of us in the dark.

At the risk of insulting the engineers among us, and quite possibly of oversimplifying things a bit here and there (although we'll try not to), we're taking this stab at explaining accurately just how waveguide works. Along the way, we'll examine the posibilities of making our own.

To start, though, we must point out a couple of ideas which are pretty well entrenched but are *not* how waveguide works. One of them starts out with the idea that rf reflects from a smooth conducting surface, and builds this up to the picture of myriads of reflections as the UHF wave bounces its way down the guide, reeling from side to side like a Saturday night celebrant. It's a credible enough visualization, with only one major flaw. It's false.

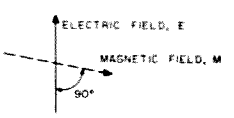

FIGURE 1

Relationships of E and M fields

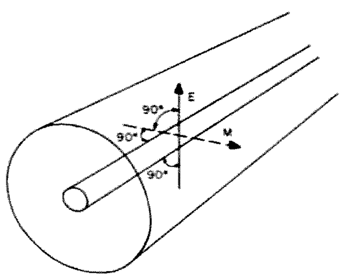

FIGURE 2

X-ray view inside coax showing field relationships

On the other hand, you may have imagined the evolution of waveguide as a sort of ultimate extension of the shorted quarter-wave line. You know of course that a shorted line reflects an open circuit at the unshorted end if happens to be a quarter wave long; it's a simple step from that to stacking millions of these shorted lines one on top of the other to form a U-shaped channel, then inverting an identical channel over the top to come up with a waveguide.

This one is closer to the truth but is still oversimplified to the point that it makes actual comprehension of waveguide mechanics difficult. Let's wipe both of these pictures out and start with a different tack. Let's go back to ordinary 80-meter antennas.

If you've read up any on the way an antenna works you may remember that any electromagnetic energy going anywhere, whether in a coax cable or in free space, is made up of two interlocked fields which are always at right angles to each other. One of these is called the electric or E field, while the other is the magnetic or M field. Like love and marriage (in the song at least) "you can't have one without the other."

The E field corresponds to a voltage potential, while the M field is the result of current flow. Now let's take a detailed look at the way these fields show up in ordinary ac, keeping in mind that while we'll talk about only one at a time, both are always present.

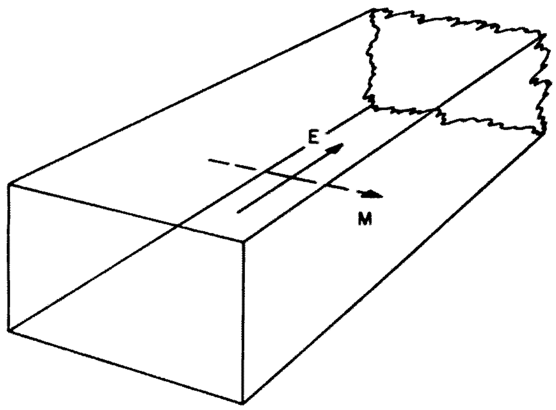

FIGURE 3
TM Wave in waveguide

By the definition of the animal, an alternating current is one which flows in one direction for a while, then reverses itself and flows back the other way. Quite naturally, the *voltage* connected with this current rises to a peak, drops back through zero, and reaches an opposite-polarity peak, following the same cycle.

And it's almost insulting to remind you that this doesn't happen simultaneously at every point along a wire—when the voltage, for example, is at a positive peak at point A, then a half-wavelength down the wire it's at a negative peak, and halfway between (or a quarter-wave away) it's at a value of zero.

All this, of course, is the basis of most of our present-day antenna theory. If we make a wire exactly half a wave long, we force the current to be nearly zero at each end. This in turn makes the voltage low and the current high near the center, and so we can feed the wire.

Let's refer to the zero points as nulls; then we can say accurately that in an ordinary wire carrying an alternating current we find a succession of peaks and nulls of both voltage and current, and that these nulls in particular are separated by a definite amount of space at any given instant.

Now let's go back and pick up the statement that an E field corresponds to a voltage potential while an M field results from current flow (it would be every bit as accurate to reverse cause and effect in this statement and say that an E field *causes* a voltage potential while an M field causes a current flow —isn't this precisely what happens in a receiving antenna?).

In an ordinary wire-line or two-wire system such as we're familiar with at lower frequencies, both the E and M fields associated with our electromagnetic energy are at right angles to the conductor at all times. If we represent the E field's direction of action by a solid arrow and the M field's direction by a dotted arrow, then Fig. 1 is a pictorial representation of the situation in free space while Fig. 2 shows us what goes on inside a coaxial cable, for instance.

And any time that both the fields are at right angles to the conductor while they're at right angles to each other as well (like the corner of a cube), the conventional concepts of voltage and current apply nicely.

However, let's assume that we launch our pair of fields into some space which is not quite free. To be specific, let's launch them into a confined space which extends indefinitely in one direction but which is surrounded in all other directions by a conducting surface. The inside of an infinitely long pipe would be one such example; to make things easier, though, let's visualize it as a rectangular pipe.

Now if the frequency of our wave happens to be such that any two nulls in *either* of the two fields can touch the conducting wall at the same instant, the wave will "lay over" so that the nulls involved do just that and will remain in that position. Fig. 3 shows what happens if a pair of the M-field nulls happen to coincide with the walls of the tube. The E-field now points down the direction of the axis of the tube, while the M-field is transverse (engineeringese for cross-wise), and the resulting configuration is known as a Transverse-M or simply TM wave.

A bit of simple arithmetic will show that the *lowest* frequency at which this can happen in a pipe of given size will be the one at which the two widest-spaced sides are just a half-wave apart, since nulls occur only once every half wavelength. However, there will be no upper limit! The second, third, fourth, fifth, etc., all the way to infinitieth harmonics of this frequency will also find the same happy circumstance that two of their nulls coincide with the walls of the guide. *This is what the books mean when they say that a waveguide has an infinite number of modes.* They do *not* mean that it will always support all of these modes at once.

We have just examined the TM wave; in exactly similar fashion, the nulls in the E-field can coincide with the walls, giving us a TE wave with the magnetic field projecting down the axis of the guide. This is diagrammed in Fig. 4.

The choice of whether you have a TE wave or a TM wave in a guide depends primarily upon how you feed the energy into the guide

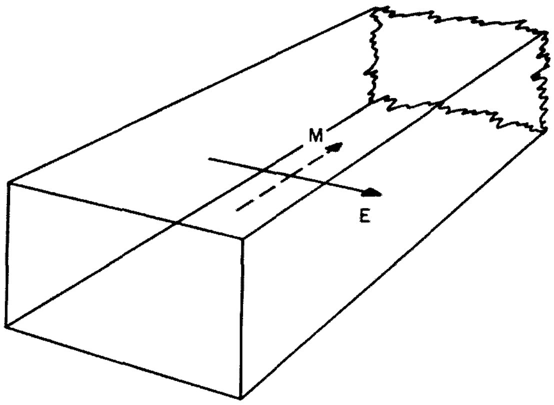

FIGURE 4
TE Wave in waveguide

in the first place, since it is obvious by the nature of the beast that any guide capable of supporting a TM mode will also support the corresponding TE mode.

If you couple in inductively, with a loop, after the fashion of a low-frequency coupling link, you will probably get TE waves. On the other hand, capacitive coupling with a probe is more likely to give you TM modes in the guide. Cavity coupling can give you either, depending on the position in both the cavity and guide where the coupling is made—but that's something a bit deep to get into right at this point.

One more point before we get into the question of do-it-yourself waveguide—and that's the effect of "discontinuities" in the guide.

Since the effective propagation of energy down a waveguide depends critically on the distance between two parallel walls of a rectangular guide (we'll get into circular guide later), it should be obvious that *any* variation in this distance will have some effect. Carried to extremes, this would indicate that variations in spacing of 0.000001 inch might be harmful—and if the frequency is high enough, they certainly would, since that distance might represent a quarter-wavelength!

For professional use, the dimensions are usually controlled to 0.001 inch. Larger variations will certainly introduce some reflections and subsequent losses, but it's difficult to say just where the line should be drawn for amateur use.

An important thing to remember, though, is that a *gradual* change of dimension is not nearly so harmful as an abrupt change. The abrupt change usually sets up a local standing-wave pattern (in microwave terminology, it "excites a number of higher-order modes") which results in bad SWR and excessive power loss throughout the system. Any dent, for instance, which you can see is probably too big!

Now to some practical material on our subject. As you have seen, a waveguide has no upper-frequency limit. However, by careful choice of guide dimensions, you make it easy to excite in only one mode and difficult to feed in any other—and this is the normal way the problem is handled.

If a rectangular guide is made wider than a half-wave, but less than a full wave in width, then only the dominant mode (the case where only two nulls exist in the transverse field, and both coincide with the guide wall) can be carried.

To avoid simultaneous excitation of another mode involving the top and bottom of the guide, the inside height of the guide is usually made approximately one half the width. This prevents any vertical mode from being supported.

The restrictions on width automatically mean that a guide of given size is normally used within only a 2-to-1 frequency range even though it can carry energy up to much higher frequencies. Additional considerations of attenuation and the possibility of accidental excitation of unwanted modes, with resulting undesired coupling out of the guide, make the actual restriction even narrower: maximum operating wavelength is usually taken as 1.65 times the inside width of the guide, while minimum wavelength is about 1.05 times inside width.

To put it into megacycles, a 1.338 inch high by 2.833 inch wide (inside dimensions of 1½x3 guide with 0.081 inch thick walls) is recommended for the frequency range 2,540 to 3,950 mc. For the next skip, from 2,540 to 6,000 mc, dimensions are 0.838 high by 1.838 wide (1x2 o.d.). The sometimes-obtainable ¾x1½ inch guide is used from 5,250 to 8,150 mc, while ½x1 inch guide covers 8,100 to 12,500 mc.

The RG-numbers for the guides described in the preceding paragraphs are, respectively, RG 48/U or 75/U; RG 49/U; RG 50/U; and RG 52/U or 67/U. RG 48 and 52 are brass, while 75 and 67 are aluminum.

So how about circular waveguide, as promised?

The exact description of how it works requires pages of complicated mathematics and so it will be skipped; in essence it amounts to the same thing.

In practice, rectangular guide is easier to work with. However, copper and brass pipe and tubing are somewhat more available to

eager UHF experimenters than is surplus rectangular waveguide.

One major difference between circular and rectangular waveguide is that circular guide is recommended only for a narrow frequency range as compared to the rectangular version. The following chart lists the diameters of circular guide recommended for various frequencies:

Outside Diameter	Wall	Frequency Range (MC)
3 in.	0.065 in.	2750-3130
2⅝	.065	3130-3610
2¼	.065	3710-4230
2	.065	4170-4840
1¾	.065	4840-5500
1½	.042	5550-6380
1⅜	.065	6250-7230
1⅛	.032	7230-8330
1	.032	8330-9680
⅞	.035	9680-11,100

. . . K5JKX

New Ones from Old Ones

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In this age of the 22 tube super-sniffer receiver offering the near-ultimate in selectivity and sensitivity, many of our cohorts are overlooking the possibilities of some of the least expensive and most satisfactory communications receivers available today. These units are the older receivers currently available on the used equipment market for a nominal price. After all, it hasn't been too many years since the SX-25 was considered a prime piece of used gear and the HQ-129X and S-40 were the latest things out. Do you remember the Howard receivers? Many of these old ones still have much to offer.

Don't expect to be able to pick up an oldie but goodie, plug it in and be in competition with a new Brand X. It just ain't so. BUT, with a reasonable amount of effort and common sense, coupled with a few small parts, most of these old inhalers can be made to turn in a very creditable performance on 160 thru 10 as well as the general coverage bands. They also make excellent tuneable *if's* for converters.

The best procedure for utilizing these receivers is to put them in the best possible condition and then modify them to obtain the desired performance. There are advantages to this approach other than saving money. One of the most painless ways to learn the inner secrets of receivers is to work with them. This also provides a good outlet for those of us who like to build but don't have the time (or ambition) to start from scratch.

Also, don't overlook some of the choice surplus items still available. The same basic rules will apply except that most of the surplus units will require the construction of a power supply and a bit more work.

Now that you are properly inspired, choose your weapon. Remember, you can modify as little or as much as you wish. The newer the receiver, the less the work. Select a used receiver according to your pocketbook and how much work you are willing to do. You can usually purchase just about any post war model by mail. You must visit the store for older models. You may be able to get a bargain from an individual or from Joe's Junk Shop. Equipment advertised as reconditioned will usually be working reasonably well, but never is in the very best of condition. The stores are honest but they just can't afford to invest $30.00 worth of time in reconditioning an old receiver in order to sell it for $69.50. By visiting the store, you can frequently have your choice of several similar units on display. If possible, make sure the one you buy is working on all bands. How well it works is unimportant. Also do your best to obtain a schematic or instruction manual. If this is not available, the manufacturer can frequently supply one for a nominal fee.

Now the fun begins. First, clean up the beast. Blow out the dust with the XYL's vacuum clear and clean the chassis. Careful! Don't bend the tuning capacitor plates or cause any shorts. Make any repairs necessary to get things working so that you at least know where you are starting. Check all of the bypass and paper coupling capacitors and replace any leaky ones. It is a good idea to replace all of the paper capacitors in any receiver over about 10 years old. As little as 10 megohms leakage can cause a reduction in receiver performance. This job is easier than it sounds. The newer disc ceramics are much smaller than the old paper units, and quite inexpensive.

Clean and lubricate the gain controls, bandswitch and other moving parts with one of the special solvents sold for this purpose. Check the bearing tension and the rotor wiping contacts on the tuning capacitors and replace any resistors which show signs of heating. Now check all of the tubes and replace any weak ones.

This is the time to replace some of the older type rf and *if* tubes with more modern equivalents. For example, a 6SG7 makes a good direct replacement for a 6SK7, giving more gain with a better noise figure. Other substitutions may be determined from magazine articles, handbooks etc. Remember that it is frequently necessary to change cathode and screen resistors when making tube substitutions. Also keep in mind that the rf amplifier noise figure is as important as gain at frequencies above about 14 mc.

Now you are ready to completely align the receiver. If you have the instruction manual, go by it. Otherwise refer to one of the good amateur handbooks for general procedures.

Don't worry if you don't know the exact *if* frequency. If the receiver has a crystal filter, you will have to measure the crystal frequency with a signal generator anyway. Be as precise as possible when aligning the filter. Crystal filters will usually work beautifully when carefully aligned, but are next to useless otherwise. If the receiver does not have a crystal filter, it really doesn't matter if you are off a couple of kilocycles as long as everything is aligned at the same frequency.

When aligning the rf stages of a general coverage receiver, the bandspread capacitor should be fully meshed if the bandset marks on the main tuning dial appear at the low frequency end of the amateur bands. The capacitor should be fully open if the marks appear at the high frequency end of the bands.

After the alignment, if you have had any luck at all, the old inhaler should be working somewhat better than when it was new. Connect it to a good antenna and listen. Use the receiver for several days and become thoroughly familiar with its operation. Find the good points as well as the bad. Determine what you think is needed and carefully plan the desired modifications. The handbooks, old magazines and other literature will be very useful at this point. The early issues of 73 are an excellent source of modification information. When planning changes, sketch out the original circuit in a notebook for future reference.

You need not be too worried about retaining the original receiver appearance. After all, it was a klunker when you first got it. Is the

thermal stability poor? More ventilation usually helps. You can add a small light bulb near the oscillator to keep things warm while the receiver is turned off. (The bulb should be off when the receiver is on.) Add a product detector for SSD. Vernier mechanisms are readily available which can be easly attached to the tuning shaft for finer tuning. Make a new bandspread dial scale for 15 meters. Add a Q multiplier or even a mechanical filter for the desired selectivity. How about an S-meter or crystal calibrator? If the front panel is too beat up, it can be repainted with a spray can and labeled with decals.

Work carefully but use your imagination and don't be afraid to try new tricks. You will be pleasantly surprised.

. . . W5FUP

Voltage Regulation

Staff

For proper operation, many electronic circuits require excellent regulation of their supply voltages. Oscillators, linear amplifiers, and may other devices must have regulated voltages for best results. And as a result, there's a lot of talk about voltage regulation. But what is it, and how can it be done? Put these questions to any number of hams picked at random, and the replies will undoubtedly amaze you.

Let's find out a little more about this regulation bit, so that if anyone asks us those questions we can give them accurate answers. And along the way, we may find a few ways to regulate voltages that turn out to be new to most of us.

As a starting point, let's find out just what "voltage regulation" means. We all know it's a measure of the change of voltage from a power source as more and more current is drawn from it, or as its input power varies—but just what are we measuring?

Surprisingly enough, the definition differs depending upon where we happen to live. By one definition, a high regulation figure indicates a "rock solid" supply, but by another equally accepted version the reverse is true: the "solid" supply has a regulation figure of zero, and the figure increases as the voltage variation gets larger!

Both definitions call regulation "the percentage change of output voltage with change in load or input," but one takes the percentage with respect to the no-load voltage while the other takes it with respect to the full-load figure. Let's plug in some figures and see what happens.

Assume we have a supply which delivers 150 volts at no load (not even a bleeder) and drops to 100 volts at 100 ma drain. The change in voltage is 50; regulation by the first definition is 50/150 or 33.3%, while by the second it is 50/100 or 50%. Let's increase current drain on the same supply to 150 ma and assume that this drops the output voltage to 75. Now regulation by the first definition is 50%, while by the second it is 100 percent. You can see how confusing all this can get.

There's a simple way to avoid all the confusion, but few hams use it. Circuit design engineers are used to drawing "equivalent circuits" for analyzing what goes on in a complex network. In these circuits, power supplies are assumed to have perfect regulation, and the actual physical loss of regulation with load is represented by a resistor in series with the supply.

This resistor, which doesn't physically exist in the circuit, is called the "source resistance" of the supply. Since $R = E/I$, it is a direct measure of the relationship between voltage at the output and current being drawn. And though it may surprise you, most power supplies behave exactly as if this situation actually existed.

For instance, in our example above the voltage dropped 50 volts with 100 ma of current being drawn. Using Ohm's Law, and dividing 50 volts by 0.1 amp, we get a "source resistance" of 500 ohms for it.

When current increased to 150 ma, the drop across the "source resistance" increased to 0.15 times 500, or 75 volts, leaving 75 volts at the output.

In addition to eliminating all the confusion brought about by the various definitions of "regulation," the source resistance concept lets us estimate quite closely what the output voltage of a supply will be if we know the amount of current it is furnishing.

For instance, in a capacitor-input power supply—or in a choke-input either, for that matter—with not even a bleeder load the voltage at the output will be very nearly equal to the peak value of the ac applied to the rectifiers. All we need do is measure the ac rms voltage, multiply by 1.414 to get peak, and this is our zero-load voltage. Now any kind of load can be applied to draw exactly 100 ma of current from the supply, and the output voltage under this load measured. Subtracting this voltage from the zero-load value gives us the amount of voltage change for 100 ma load, and multiplying this voltage change by 10 (equal to dividing by 1/10) gives us the source resistance of the supply.

With the source resistance known, all we have to do is multiply the source resistance in ohms by the current in amperes to find out how much the voltage will drop from the no-load value; subtracting this drop from the no-load value gives us the actual output.

In using this method to determine source resistance of a choke-input supply, it's better to measure output voltage at two values of load current differing by 100 ma than to use the no-load voltage, since the source resistance of this type of supply has a sharp break near zero load. This sharp break is the reason for the bleeder-current requirement, to keep the break out of the working range.

As we said before, this approach to regulation is uncommon in ham usage, and can't even be termed common practice in engineering laboratories! Therefore data on typical source resistance figures for common power supplies isn't readily available.

To get an idea of typical figures, the capacitor-input power-supply designs on page 228 of the 1962 ARRL handbook were evaluated for source resistance. All of these, incidentally, are typical good designs, so the figures should be representative of most supplies.

Source resistance of the supply was found to be determined largely by the rectifier used, and also by the transformer and choke resistances. The small supplies rated at less than 50 ma output ranged from 1500 to 2500 ohms in source resistance, due to high-resistance choke windings. Larger supplies ranged from 735 to 1350 ohms. Those supplies using type

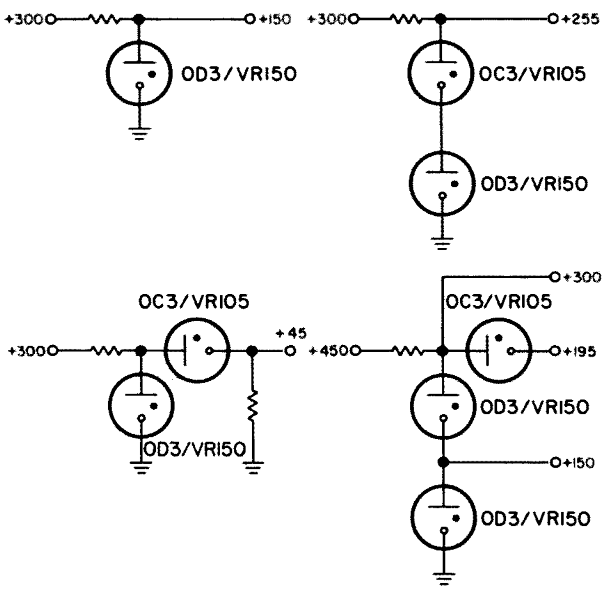

FIGURE I
VR tube hookups

5Y3 rectifiers averaged 1200 ohms; 5U4GB rectifiers averaged about 1000 ohms; and the 5V4 cathode-type rectifier circuits averaged 800 ohms. No data was taken for silicon-diode rectifiers but source impedance should be lower, probably about 80 percent of the 5V4 figure.

None of these source resistances, of course, are low enough to satisfy "regulated-voltage" requirements for oscillators, etc. Even a 500-ohm source resistance drops output voltages by 5 volts for every 10 ma increase of load current. In a SSB linear, screen current can swing as much as 50 to 60 ma, so a 500-ohm supply would allow screen voltage to vary by 30 volts or so. This would not be acceptable.

Because of this, additional means must be taken to lower source resistance of a power supply. If the source resistance could be reduced to zero, the output voltage would remain constant regardless of load. At even 1 ohm, it would take a full amp of drain to change the voltage by a single volt. For many purposes, a 100-ohm source resistance is adequate; this lets voltage change by 0.1 volt per milliampere. In the linear example of the preceding paragraph, screen voltage would remain within 6 volts of design figure, which would be acceptable.

Three basic means exist to reduce the source resistance; all involve adding some circuit element. A gas-discharge tube maintains a constant voltage across itself, varying its own resistance to accomodate changes in current. Adding a tube of this sort holds the voltage more constant, which as we have seen is the same thing as lowering source resistance.

A battery, by chemical action, holds voltage constant also. If voltage becomes lower than that of the battery, the battery makes up the difference, while if it is higher the battery simply charges up to hold the excess energy.

Finally, certain semiconductor junctions have the same constant-voltage effect as the gas-discharge tube, and can be used in the same manner.

Five types of devices are available for putting into use these basic means of regulation: They are the VR tube, the neon bulb, the battery, the Zener diode, and (for small voltages) the silicon power diode, Let's look at them in order.

The familiar VR tube is the commercial version of the gas discharge tube. It's designed to hold voltage constant at its design through a range of load current variations which depend upon tube type. The larger "VR" series handle current swings between 5 and 40 ma, and come in 75, 90, 105, and 150-volt models. The smaller "OA" series had a current range of 5 to 30 ma, in 105 and 150 volt ratings.

If the voltage you need comes out to anything which can be made up of these various values, and the current swing is within ratings, the VR tube is the simple answer. To get a 255-volt regulated source, for instance, you would use a 105-volt and a 150-volt tube in series.

You can also get some unusual values by subtracting one VR tube from another; to have 45 volts regulated, use a 150-volt tube, then place a 105-volt tube in series with the load. Output will be 150 minus 105, or 45 volts.

All VR tubes require a source voltage considerably higher than the operating voltage, since they take some extra voltage before they will "fire" and begin operation. This, in turn, requires a current-limiting resistor. Fig. 1 shows the various hookups using VR tubes.

To calculate the value of resistor needed, subtract the operating voltage from that of the supply and divide by maximum load current plus 5 ma for the tube. The results will be the resistance; power rating of the resistor should be voltage drop times current flow, times two for a safety factor.

The conventional VR regulator is widely used, and many of us tend to believe it holds "perfect" regulation. Actually, however, voltage across the tube depends to some degree on the current through it. The source resistance of a single VR tube works out to be approximately 80 ohms; using two or more tubes in series won't appreciably change this figure, but the "subtraction" hookup may increase the resistance to 150 ohms or so.

Often we have need for a regulated voltage where little space is available for a VR tube, and the current swing is relatively small. A handy substitute for the VR tube, still in the gas-discharging family, is the ever-ready NE-2 neon bulb.

Like the VR tube, the NE-2 maintains reasonably constant voltage across its terminals. It is rated to handle only 2 ma, however, and therefore shouldn't be used where current swing will be high. One handy spot for a NE-2 or two is in regulating the screen voltage of an oscillator; current variations here are usually tiny and the object is to keep changes in input voltage from affecting the tube.

The exact value at which any given neon tube regulates can be determined only by experiment, which may be a drawback. The range will usually be between 50 and 130 volts; most of them tested here seem to average about 70 volts but this reading is in conflict with most published data, which claims an average regulating voltage of 55. To be sure, measure it!

The NE-2 hookup is identical with that of a VR tube, and all the same tricks can be used so long as we remember that the current rating is extremely small. But don't let that small current rating knock the neon completely out of the picture; a bit later we'll see how to increase it.

About the only place that a battery is useful as a voltage regulator is in grid-bias supplies, where the battery is still sometimes employed to prevent having to build a separate supply. Another use for the battery as a regulator is as the reference element in an active regulator, but that's getting ahead of ourselves.

Which brings us around to the world of semiconductors, and the Zener diode as a start.

The exact happenings inside the Zener diode which make it work as it does are rather complicated, and anyone interested is hereby referred to a paper by Dr. C. A. Escoffery of International Rectifier Corporation, which forms the first chapter of IRC's "Zener Diode Handbook." But this knowledge isn't necessary to make good use of the Zener.

All we really need to know about the Zener diode to use it is that, when connected in the "forward" direction it's a conventional rectifier. When connected in "reverse," however, it (like a conventional rectifier) is the equivalent of an open circuit *until* a particular voltage is reached. At that point, it "avalanches" and prevents any additional rise in voltage. So long as the current through it is held to a safe

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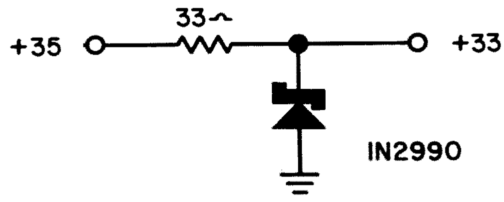

FIGURE 2

Basic zener diode circuit

value, no damage is done.

Thus a Zener diode must be connected so that it is always in "reverse" to prevent shorting out the power supply, and it must also be used with a current-limiting resistor to prevent self-destruction.

This leads to a hookup (Fig. 2) which appears identical to that of a VR tube, and the two devices are indeed very much alike. However there are a couple of important differences!

First of these differences is that instead of being limited to four basic voltages and the combinations you can make from them, as with VR tubes, you have almost no limit to the voltage range available. Zener diodes are available from less than 4 volts up to 150 and higher.

The other differences is that the Zener diode requires no "striking"voltage. Where the VR tube must be supplied from a voltage source considerably larger than the VR rating, because the firing or striking voltage is approximately 25 percent above operating voltage, the Zener diode has no such over-voltage requirement. It can operate from a supply only a volt or two greater than the Zener rating.

A less important difference is in the frequency response. While a VR tube has only a short "reaction time," enabling it to regulate out audio-frequency ripple, the Zener diode's reaction time is even shorter. The Zener is as useful at 100 kc as it is at dc.

Source resistance of a Zener-regulated power supply is typically less than 3 ohms, and frequently comes out to be less than one ohm. For all practical purposes, this is near-perfect regulation.

For extremely small regulated voltages, two Zener diodes can be arranged in a difference circuit as shown in Fig. 3. The output voltage will be the *difference* between the diode voltages, and can be only a small fraction of a volt.

A similar circuit providing an adjustable regulated voltage appears in Fig. 4. Source resistance of this circuit will be approximately equal to ½ of the resistance of the potentiometer, since at midpoint the two halves of the pot are in parallel between the load and the regulators.

When working with very small regulated voltages, below 2 volts, a useful trick is to use ordinary silicon power diodes as regulators. Thse diodes have a "voltage offset" of between ⅜ and ¾ volt in the forward direction; that is, approximately half a volt must be applied to them before any current will flow. Then, with current flowing the half-volt still drops through the diode.

Thus if a diode and resistor are placed in series across a voltage supply, the drop across the diode will be about ½ volt.

While the regulation is nowhere near as precise as that obtained with a Zener diode, and like the neon tube the voltage can be determined only by experiment for a specific diode, the idea is still useful.

For instance, fixed bias of 1.8 volts can be obtained on an audio amplifier by using three silicon diodes in series in the cathode lead of the tube. Each diode will drop about 0.6 volt, so the three total 1.8 volts. No bypass capacitor is required as the ac variations pass on to ground. This use is shown in Fig. 5.

To sum up basic regulating devices, we have a number of such devices available. None, however, is completely adjustable, and all suffer from restricted range of current swing. Adding means of adjustment reduces the regulation by increasing sources resistance. Thus basic devices are not always adequate to handle our needs.

Fortunately, another class of regulators is available which fills in the gaps. For want of a better generic term, let's call them "active regulators."

An active regulator uses an amplifying element such as a tube or a transistor to lower the source resistance of a power supply. Basic regulators may be included, or may be omitted. With proper design of an active regulator,

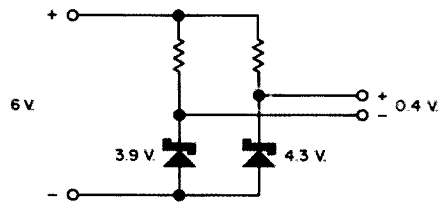

FIGURE 3

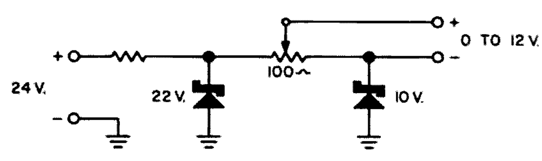

FIGURE 4

including cascaded basic regulators, the ultimate of zero source resistance can be obtained —or source resistance can even be made negative, so that the output voltage of the supply rises with increasing current. This, however, is usually undesirable.

Before getting into such complex arrangements, though, let's examine a couple of elementary active regulators which do not include basic regulators in their designs. Neither of these will reach the low source resistances of a basic regulator, but both are adjustable and their source resistances are low enough to meet many practical needs.

The first of these regulators, shown in Fig. 6, is a dc cathode follower. It acts as an impedance transformer, just as the more conventional cathode-follower amplifier, to transform a high source resistance down to a lower figure; the result is improved regulation.

Operation of this circuit (not a generally known one, by the way) can be made a bit more clear with an example. Let's asume that the tube is half of a 12AU7, supplied from a 150-volt source and delivering 100 volts at a maximum current of 10 ma.

The 12AU7 will then have a plate-to-cathode voltage of 50, and a current of 10 ma. Consulting the tube curves shows that these conditions require a grid bias of +2 volts with respect to cathode, so that grid voltage must be +102 from ground.

The voltage divider in the grid circuit is proportioned to deliver this voltage; at design values, the circuit delivers its 100 volts at 10 ma. If current drain drops to 5 ma, the required grid bias drops to 0 volts; since grid voltage is fixed, the cathode voltage rises to this value, or 102 volts. Since output voltage varies 2 volts for a 5-ma change in current, the

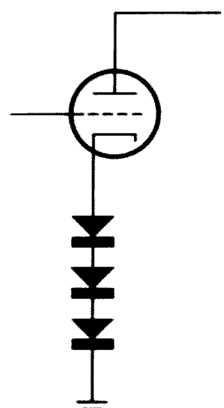

FIGURE 5

Power diode regulators

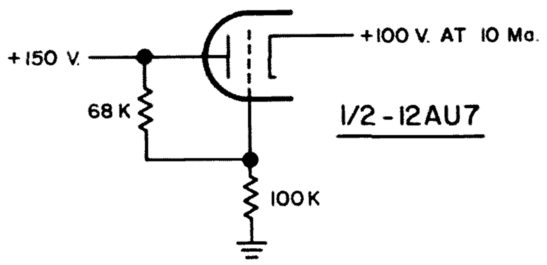

FIGURE 6

Elementary series regulator

source resistance of this regulator is 400 ohms.

If input voltage goes up to 200, the grid bias will rise to 134. Assuming that the load remains constant, the cathode voltage will again rise until the bias is just right to allow proper current flow. This happens with a output voltage of 134 and a load current of 13.4 ma.

Which doesn't sound too good until we stop to notice that a 50-volt rise in input voltage, from 150 to 200, resulted in only a 34-volt rise in output voltage. This is a reduction of 32 percent in input voltage variation.

The other of the elementary active regulator circuits is shown in Fig. 7, and is known as a degenerative regulator. It is similar to the circuit of Fig. 6 except that the grid bias is now taken from a divider across the output rather than from across the input. This allows better regulation against changes in input voltage.

However, this circuit cannot be used when the regulator tube requires positive bias as in the previous example. Let's see what happens when we use the Fig. 7 circuit to drop a 250-volt input down to 150 volts at 6 ma, with half of a 12AU7.

To find out what happens, let's just design the circuit. The first step we must take is to determine the resistance of the potentiometer. It carries almost no current, since its only load is the grid of the 12AU7 which is always negative, so its resistance can be high. Let's

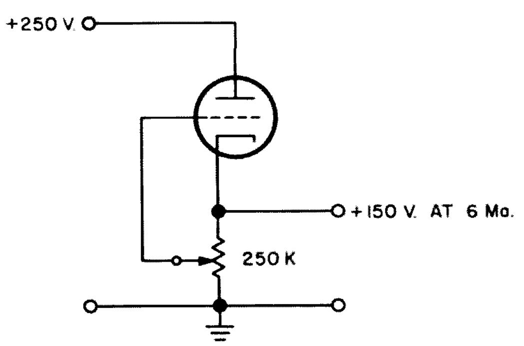

FIGURE 7

Degenerative regulator

arbitrarily pick a resistance which allows 1/10 of the load current to pass through the pot. With a specified load current of 6 ma, this means 6/10 ma through the pot; output voltage is specified as 150 volts, so the pot's resistance must be 150 divided by 0.6, or 250K ohms.

Since we're dropping 250 volts to 150, 100 volts must appear across the tube. The tube must also pass load current of 6 ma and bleeder current of 0.6 ma, for a total of 6.6 ma. Checking the tube charts for the 12AU7 we find that with a plate to cathode voltage of 100, 6.6 ma will flow through if grid voltage is −2.

This grid voltage is with respect to cathode rather than to ground, and since the cathode is at +150 then the grid must be at +148. The potentiometer arm is set for this voltage, and we get 150 volts out.

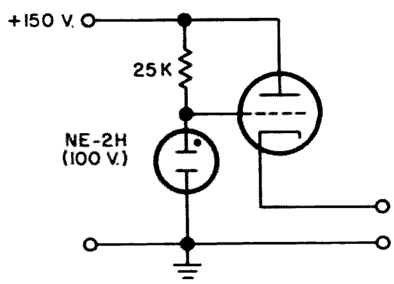

FIGURE 8

Regulated supply

Now let's see what happens if input voltage rises from 250 to 400. Since feedback is involved, we can't do a step-by-step analysis, but we can say that as the output voltage rises, the grid-to-cathode negative bias also increases, reducing current flow and thus holding output voltage down. For the exact values given in our example, the output voltage rise would be 87.6 volts (compared to an input voltage rise of 150 volts). Only about half the increase would be passed on to the output. When it comes to changes in load, the circuit of Fig. 7 is to be avoided. The source resistance of the example is higher than 7600 ohms; the supply is virtually unregulated for changes in load.

Either of the two elementary circuits, however, can be vastly improved by adding one of the basic regulators to them. To start the simplest way, let's convert the circuit of Fig. 6 into a truly regulated circuit, as drawn in Fig. 8.

Taking the left-hand half of the circuit first, we have a simple VR regulator except that we're using a NE-2H selected for 100-volt regulating point. The 25K resistor allows 2

ma to flow through the bulb.

The right-hand part of the circuit is the cathode-follower regulator of Fig. 6. If as in our previous examples we use half a 12AU7 here, let's see what happens with various loads and input voltages.

With no load at all taken from the supply, the grid bias from grid to cathode will be about —3 volts. Since grid voltage is clamped by the NE-2H at 100, this means cathode voltage will be about 103.

With 5 ma being taken by the load, a plate-to-cathode voltage of 50 and a grid bias of 0 volts will allow the current flow. This means cathode voltage will drop to 100 volts.

Taking 10 ma in the load, plate-to-cathode voltage must still remain in the neighborhood of 50 volts; for 10 ma to flow at this plate voltage, the grid must be about 2 volts positive to cathode. This, in turn, means cathode voltage must fall to 98 volts.

Our 5-volt change in output was brought about by a 10-ma change in load current, so the source resistance of the circuit is approximately the same as that of the Fig. 6 circuit. But let's see what happens when input voltage changes.

If the input voltage goes up to 200. the grid voltage of the tube will remain the same because of the regulating action of the NE-2H. If load current is zero when this happens, the output will climb to approximately 107 volts. Seven volts is cut-off bias for a 12AU7 with 100 volts between plate and cathode, and with 100 volts on the grid the cathode must be seven volts more positive in order to cut

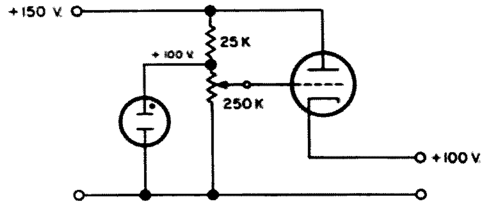

FIGURE 9
Electronic regulator

the tube off and satisfy the zero-load-current condition.

With 10 ma being drawn, the output voltage will be only 101. Again, with 100 volts between plate and cathode, a grid bias of −1 volt allows 10 ma to flow, and with the grid held at 100 volts the cathode must be one volt more positive to satisfy the requirements.

So at 10 ma load, varying input voltage from 150 to 200 causes a change of only 3 volts in output. This is a vast improvement over the 34-volt change of the Fig. 6 circuit, so that the circuit of Fig. 8 represents a marked improvement even though the regulation for changes in load current is about the same.

So far, we've been using half a 12AU7 as our control tube, and this tube has only limited current-handling capacity. Let's see what happens if we replace it with a triode-connected 6DQ5, in the circuit of Fig. 8.

Now, at no load, the grid voltage is still 100. Cut-off voltage is approximately −16, so that the cathode voltage would be 116. Now let's increase the load to 160 ma. With both plate and screen at 50 volts (since the tube is triode-connected) it takes 0 volts between grid and cathode to let this current flow. Resulting output voltage will be the same as that on the grid, or 100 volts. Thus the source resistance of this regulator becomes 16/0.16 or 100 ohms, and the current capacity is more than 4 times as great as that of the largest VR tube. Now, the neon tube is capable of competing.

For an even more useful version of this circuit, it can be modified as shown in Fig. 9. The potentiometer resistance must be much higher than that of the dropping resistor, so that the voltage at the top of the pot is high enough to fire the regulator tube. Now, output voltage can be varied by adjustment of the potentiometer, from a minimum near zero to a maximum determined by the voltage of the regulating tubes.

The circuit of Fig. 9 provides the stepping stone to the more complex but much more "solid" full electronic regulators. These circuits use the same basic principle as that of the Fig. 9 circuit, except that the difference between output voltage and the desired level is amplified by a "control amplifier" rather than being dictated by design of the series tube.

Fig. 10 is a block diagram of a generalized full electronic regulator; all these functions are present in all electronic regulators, but they are frequently somewhat disguised.

The "reference element" is usually a VR tube, often of somewhat special design for maximum voltage stability, but in transistorized regulators may be a Zener diode. The "sampling" circuit is usually a voltage divider across the regulated output, with bypass capacitors to shunt any ac on the line around the divider. The "differencing circuit" may be any type of circuit which produces as its output the *difference* between two input voltages, while the "amplifier" is a high-gain dc amplifier. The "gate" is the cathode-follower stage we've been talking about since Fig. 6.

The "reference element" supplies a known voltage, which is subtracted from the output voltage through the sampling and differencing blocks. Usually, the sampling circuit picks off a portion of the output voltage which is nominally equal to the voltage of the reference element, so that the difference is zero if the output voltage is precisely at design value. If output voltage is a trifle high, the difference output is a small positive voltage, while if output is low, the difference is a small negative potential.

The difference output then goes to the amplifier, where the small changes become large. The amplifier output controls bias on the gate tube, so that if the output voltage of the supply tends to be a bit high the grid voltage of the gate tube falls slightly, increasing the plate resistance of the tube and reducing the output. Thus any change in output voltage is made to cancel itself out.

If amplifier gain is sufficiently high, source resistance of a supply of this nature can be made as close to zero as we like. If an amplifier with voltage gain of 1000 is available, the source resistance can be made as low as 0.01

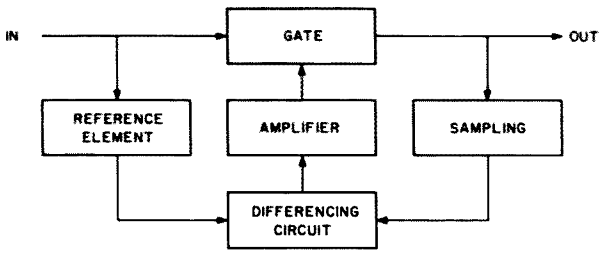

FIGURE 10
Adjustable regulator

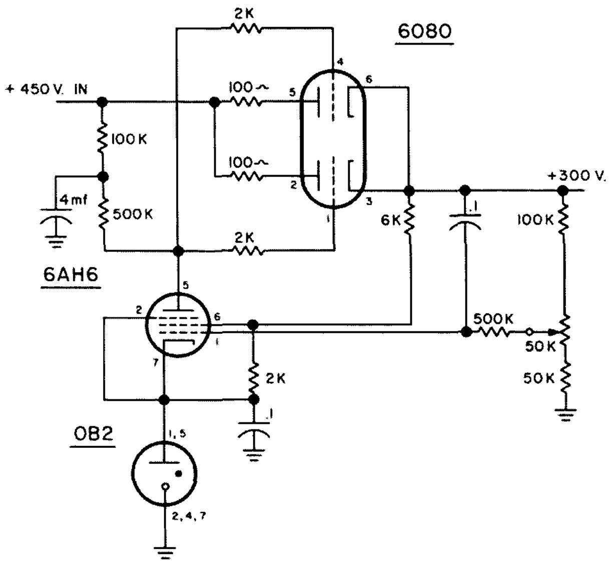

FIGURE 11
Typical electronic regulator

ohm—near enough to zero for almost any purpose.

A typical regulator of this type is shown in Fig. 11. This regulator delivers 300 volts at load currents from zero to 100 ma, from a 450-volt dc source. Its source resistance is only 6.1 ohms. The only critical parts values in this circuit are the resistors in the string from the 6080 cathode to the OB2 anode, which are chosen to provide a 25-ma bleeder load for the swinging choke in the 450-volt source. All other values are typical for this type of circuit.

This circuit, incidently, is one in which some of the functions shown in Fig. 10 are disguised.

The OB2, for instance, is the reference element although it takes its voltage from the output rather than from the input side of the gate. The 6AH6 combines the differencing circuit with the amplifier; since the reference element is in its cathode while the sampling-circuit output goes to its grid, the output is an amplified version of the difference between them rather than of either voltage alone. The 6080 is the gate tube (the 6080, incidentally, is a rugged version of the 6AS7, which can be used instead), and the sampling circuit consists of the voltage divider across the output. The 50K pot is used for minor adjustment of output voltage, to allow for parts tolerances elsewhere in the circuit, and will require checking whenever any of the tubes is replaced.

Many variations of the circuit are possible. If output voltage is to be considerably higher than that of the reference element, the upper resistor in the sampling-circuit string can be replaced with VR tubes. These simply subtract volts from the output, rather than dividing the total, so that a change from 300 to 310 volts shows up at the sampling tap as a move from 150 to 160 volts. With the divider, the same change would show up as a shift from 150 to 155 volts.

If very high output voltage is desired, the entire regulator circuit can be "floated" above ground and the ground returns shown in Fig. 11 would then be made to the top of a VR string. In this way, as shown in Fig. 12, regulation can be provided in the 1000-volt range.

The full current swing of the regulator is retained in the hookup of Fig. 12, since the VR string merely establishes a 705-volt "ground" potential for the regulator circuit itself and no load current passes through it. Thus this type of circuit finds wide use for regulating screen-voltage supplies for SSB linears which require 750 to 1000 volts screen voltage, with current swings exceeding the values readily achieved with VR tubes.

Transistorized regulators may be designed using the same principles illustrated in Fig. 10, but with semiconductors instead of tubes for all elements. Since extensive design articles have appeared in the recent past in other ham publications, and most comprehensive design data is included in IRC's "Zener Diode Handbook," we won't go into them further here.

Suppose, for instance, that we have a transthe way, though, lend themselves to various uses.

Suppose, fo instance, that we have a transmitter which requires regulated voltage for its oscillator, for the final screens, for the modulator screens, and for the speech preamp. Think we can do it with two VR tubes?

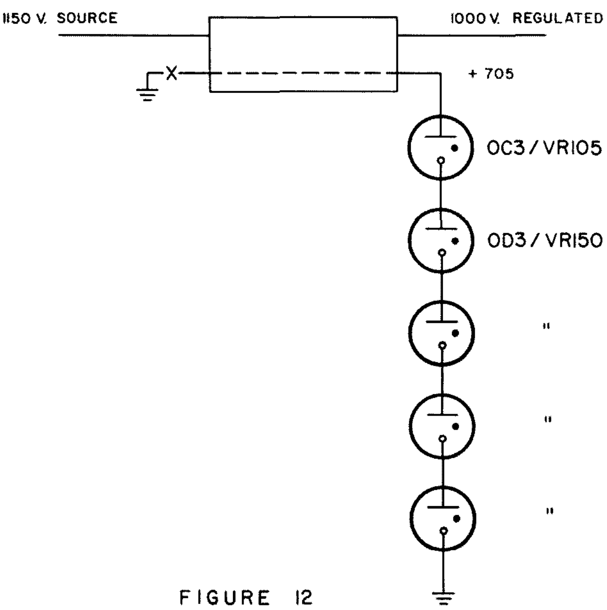

FIGURE 12
Floating regulator

By using the circuit of Fig. 9, and hanging several pots and control tubes onto a single VR string, it's easy.

Just set the VR string for 300 volts at maximum tube current with maximum expected supply voltage, and hang on the pots. Select control tubes to fit the requirements of the circuit being regulated; a 12AU7 might do for the oscillator but the modulator screens would probably like a 6V6 better. Adjust each pot individually for proper voltage in its regulated circuit, and we're in business.

Only one thing must be kept in mind when doing all this; that's heater-to-cathode voltage breakdown possibility. Most modern tubes are rated to withstand a potential of 200 volts between heater and cathode, with cathode positive, but a few are not. And if the regulated voltage exceeds 200, breakdown is possible anyway.

Best way to handle this is to supply the regulator tubes from a separate filament line, and tie one side of the filament line supplying them to a DC voltage which is equal to the average of all regulated voltages (if no more than 250 to 300 volts separates the highest and lowest regulated voltage). Then heater-cathode voltage ratings won't be exceeded.

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What Every Amateur Should Know

ITU—IRAC—FRC—FCC—IFRB

Wells Chopin W2DUD
118 Woodmancy Lane
Fayetteville, N. Y.
Pictures by Eli Hobaica K2YFP

We are avid users of one of the worlds most important resources, spectrum allocation. There is just so much of this resource so until someone invents negative frequency we will just have to resign ourselves to using techniques to conserve it. In addition we must use it wisely and fight for it desperately. This limited spectrum is the direct cause of the extreme pressures of diverse groups to obtain space for their groups. The fight for frequency allocation (and we amateurs are part of it) is really a blue chip poker game that is extremely complicated by the demands and needs of the Military-Government-Commercial and private services. There is a great feeling by all groups that their interest is more important than any other group and each is out to prove it. Millions of dollars are spent every year by these groups with permanent lobbys in Washington whose sole job is keeping what they have and looking for a slice of the other fellows spectrum for their own group. They all are looking at our ham bands covetously. All of this grows more complicated daily by the rapid growth of the worlds population and its inherent dire

Fig. 1

need for communications. Then toss in the enemies of the free world imprications and those who are interested in only spectrum for themselves. Then add the interests of friendly foreign nations you have the makings for a real donniebrook at the ITU in 1965. The pressures over the years to relieve us of frequencies has been extreme. There is no question that the pressures will become greater. In the past the ARRL has done a good job in representing our interests, however, I think the time has come to reappraise our situation in Amateur Radio. Unfortunately some of us take this valuable resource, use it and take it for granted. Perhaps its time for all of us to make a contribution to perpetuate amateur radio. You ask—what can I do? Well the first thing you can do—is to learn a little about this wonderful hobby of ours.

You should know how we came into existance. If you are interested in history try Two Hundred Meters and Down by Clinton Desoto and then pickup some history books in the library to get the commercial side of the picture.

This whole radio business started way back in the 1800's when the names of Michael Faraday (perhaps this is where we got mike farad) Henry, Ohm, Kirchoff, Ampere, Hertz, Morse and then the more recent names of Marconi, Fleming, Tesla, DeForest, Armstrong and others appeared. Maxwell really started the whole thing with his famous theory ie. he reduced all known electrical and magnetic phenomenon to motions in the form of waves in a substance which due to the etheral like nature of this phenomenon he called ether. Like he said, was a wave in space, heat another and electrical another. The difference between them was in the rapidity of their oscillation. Light waves were short and heat waves long and between them was an enormous space about which nothing was known. This un-

known space trigged off a rash of scientific experiments leading eventually to radio.

While researching for material for this article I was surprised to learn that Marconi was really not the first to use ether for transmission as Dr. Mahlon Loomis the brother of the famous radio author Mary Texana Loomis, patented telegraphy through the atmosphere in 1872 as shown in Figure #1. For those who do not recognize it the background gadget is a spark gap—a key item in the transmitters of those days. Those early days must have been exiting—imagine yourself in 1872 when even wire telegraphy was new— then along comes ether transmission.

It took a sharp persistant intelligent youth named Marconi who realized the commercial significance of radio and took advantage of all the past and started commercial radio. Marconi did not invent radio as so many think—he took advantage of and understood and promoted this new communication tool. Marconis lot was not easy—he encountered superstition, untold opposition and harrasement but he finally succeeded in transmitting a mile via the ether and by early 1896 had increased this distance to four miles. In this same year, twenty-six years after Loomis, Marconi received his famous British Patent #7777.

It was obvious from the start that some form of international agreement was necessary, because this new medium was used aboard ships who sailed the seas. In the early days things were quite loose in Amateur Radio one merely used his initials for call letters. The events in the international regulation of telephony and telegraphy over wires and then radio was really the history of what is now known today as the ITU International Telecommunication Union.

These events were:

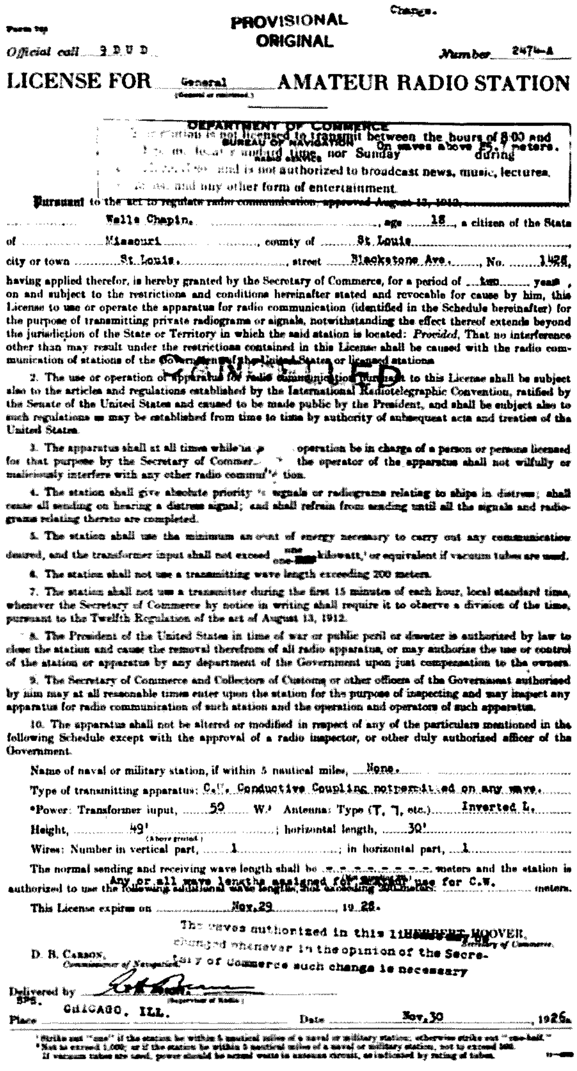
1849—The telegraph first used internationally.

1865—Foundation of the International Telegraph Union by twenty States with the adoption of the first Convention. First Telegraph Regulations.

1868—Vienna Conference. Bureau of the Union set up in Berne.

1871-2—Rome Conference.

1885—Berlin Administrative Conference. First ITU provisions for international telephony.
1903—Berlin. Preliminary Radio Conference of nine States.
1906—Berlin, First International Radio Conference with 29 States. Convention and Radio Regulations drawn up. Adoption of SOS Signal.
1912—London Radio Conference. Improved Radio Regulations.
1924—Paris. Creation of CCIF (International Telephone Consultative Committee).
1925—Creation of CCIT (International Telegraph Consultative Committee).
1927—Washington Radio Conference with eighty States. Establishment of CCIR (International Radio Consultative Committee). First allocation of radio frequencies to the various radio services.


Form 769

PROVISIONAL
ORIGINAL
Change.

Official call 9 D U D   Number 2474-A

LICENSE FOR General AMATEUR RADIO STATION
(General or restricted.)

DEPARTMENT OF COMMERCE
BUREAU OF NAVIGATION
RADIO SERVICE

This station is not licensed to transmit between the hours of 8:00 and 9:30 p.m. local standard time, nor Sunday during church services, and is not authorized to broadcast news, music, lectures, sermons, and any other form of entertainment. On waves above 85.7 meters.

Pursuant to the act to regulate radio communication, approved August 13, 1912, Wells Chapin, age 18, a citizen of the State of Missouri, county of St. Louis, city or town St. Louis, street Blackstone Ave., No. 1428, having applied therefor, is hereby granted by the Secretary of Commerce, for a period of two years, on and subject to the restrictions and conditions hereinafter stated and revocable for cause by him, this License to use or operate the apparatus for radio communication (identified in the Schedule hereinafter) for the purpose of transmitting private radiograms or signals, notwithstanding the effect thereof extends beyond the jurisdiction of the State or Territory in which the said station is located: *Provided*, That no interference other than may result under the restrictions contained in this License shall be caused with the radio communication of stations of the Government of the United States or licensed stations.

CANCELLED

2. The use or operation of apparatus for radio communication pursuant to this License shall be subject also to the articles and regulations established by the International Radiotelegraphic Convention, ratified by the Senate of the United States and caused to be made public by the President, and shall be subject also to such regulations as may be established from time to time by authority of subsequent acts and treaties of the United States.

3. The apparatus shall at all times while in operation be in charge of a person or persons licensed for that purpose by the Secretary of Commerce. The operator of the apparatus shall not wilfully or maliciously interfere with any other radio communication.

4. The station shall give absolute priority to signals or radiograms relating to ships in distress; shall cease all sending on hearing a distress signal; and shall refrain from sending until all the signals and radiograms relating thereto are completed.

5. The station shall use the minimum amount of energy necessary to carry out any communication desired, and the transformer input shall not exceed one kilowatt,[1] or equivalent if vacuum tubes are used.

6. The station shall not use a transmitting wave length exceeding 200 meters.

7. The station shall not use a transmitter during the first 15 minutes of each hour, local standard time, whenever the Secretary of Commerce by notice in writing shall require it to observe a division of the time, pursuant to the Twelfth Regulation of the act of August 13, 1912.

8. The President of the United States in time of war or public peril or disaster is authorized by law to close the station and cause the removal therefrom of all radio apparatus, or may authorize the use or control of the station or apparatus by any department of the Government upon just compensation to the owners.

9. The Secretary of Commerce and Collectors of Customs or other officers of the Government authorized by him may at all reasonable times enter upon the station for the purpose of inspecting and may inspect any apparatus for radio communication of such station and the operation and operators of such apparatus.

10. The apparatus shall not be altered or modified in respect of any of the particulars mentioned in the following Schedule except with the approval of a radio inspector, or other duly authorized officer of the Government.

Name of naval or military station, if within 5 nautical miles, None.
Type of transmitting apparatus: C.W. Conductive Coupling not permitted on any wave.
*Power: Transformer input, 50 W.[2] Antenna: Type (T, Γ, etc.) Inverted L.
Height, 49' (Above ground.); horizontal length, 30'
Wires: Number in vertical part, 1; in horizontal part, 1
The normal sending and receiving wave length shall be .... meters and the station is authorized to use the following additional wave lengths, not exceeding 200 meters: Any or all wave lengths assigned for amateur use for C.W. meters.
This License expires on Nov. 29 1928.

The waves authorized in this license may be changed whenever in the opinion of the Secretary of Commerce such change is necessary

HERBERT HOOVER,
Secretary of Commerce.

D. B. Carson,
Commissioner of Navigation.

Delivered by [illegible] (Supervisor of Radio.)
9PS.
Place CHICAGO, ILL. Date Nov. 30, 1926.

[1] Strike out "one" if the station be within 5 nautical miles of a naval or military station; otherwise strike out "one-half."
[2] Not to exceed 1,000; or if the station be within 5 nautical miles of a naval or military station, not to exceed 500. If vacuum tubes are used, power should be actual watts in antenna circuit, as indicated by rating of tubes.

Fig. 2

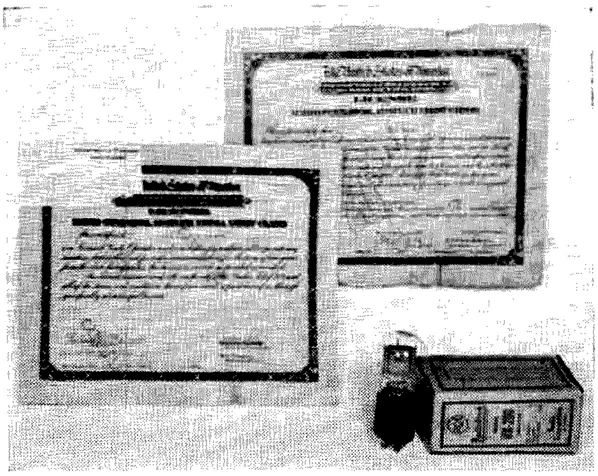


Fig. 3

1932—Madrid Conferences. Organization's title change to International Telecommunication Convention. New Radio, Telegraph and Telephone Regulations.
1938—Cairo Administrative Radio and Telegraph and Telephone Conferences.
1947—Atlantic City Plenipotentiary and Radio Conferences. Creation of International Frequency Registration Board (IFRB). New International Frequency List. Creation of the Administrative Council. Agreement with the United Nations approved.
1948—Seat of the Union transferred to Geneva.
1952—Buenos Aires Plenipotentiary Conference.
1956—Geneva. CCIF and CCIT merged into new CCITT (International Telegraph and Telephone Consultative Committee).
1958—Geneva Telegraph and Telephone Conference.
1959—Geneva Plenipotentiary and Radio Conferences.

Radio in the United States was not officially regulated in the early days and it was not until 1910 that the U.S. approved and required certain ships to carry radio. July 1, 1911 saw a Radio Division formed under the Department of Commerce to enforce the act of 1910. It was not until 1912 that an Act was passed licensing radio wireless operators. On February 23, 1826 President Coolidge signed the Dill-Whitebill that created the Federal Radio Commission (FRC) and brought order to a chaotic radio situation.. Vacuum tubes had just taken hold and had a good foothold. One of the early licenses of this period is shown in Figure 2. The extra First Class license for hams apeared in this period and

Figure 3 shows a license of this category along with a Radio Operator First Grade. Also note—the UV200 tube shown was used in this time period. The Extra First Class license had its incentive in that it let the holder use additional phone space. The FRC quickly developed rules and regulations and operated until July 11, 1934 at which time the Radio Act of 1934 was signed creating the Federal Communications commission (FCC) which we are operating under today. Figure #4 shows the books that contain the information that means life or death to ham radio.

Figure 5 shows todays rules and regulations with the Amateur Section Volume 6 Part 12 held in the hand. Figure 6 lists the complete set. You will note the FCC regulates a good deal more than Amateur Radio. These regulations are available from the government printing office and a post card will bring you the price list.

The international aspect of radio has developed to such an extent that almost no major frequency allocation can be made without considering world-wide usage. In consequence, the primary allocation of frequency bands is now determined by international treaty and other agreement ,and assignment of individual channels within those bands is made by the member nations accordingly. This now in cludes frequencies for space communication.

Therefore, it behoves us as users of this spectrum and having a real interest to retain our position—that we understand all the aspects. The (ITU) International Telecommunication Union is a most important part of our life or death story—though we amateurs have a dual job of selling our own government and people of our worth to them. So—lets take a look at the whole aspect. See Figure 7 chart. This chart is specifically shown to indicate that this spectrum allocation problem is a

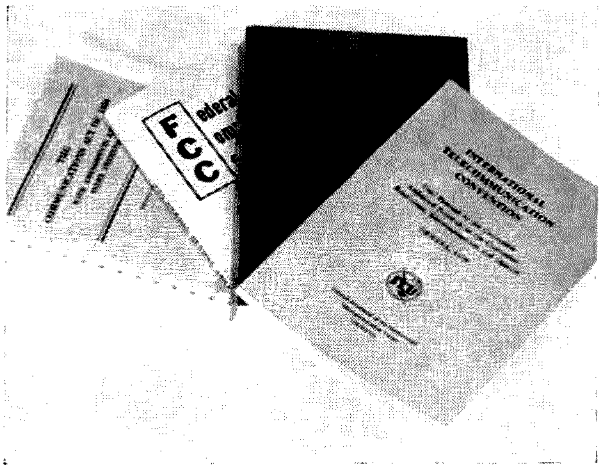


Fig. 4

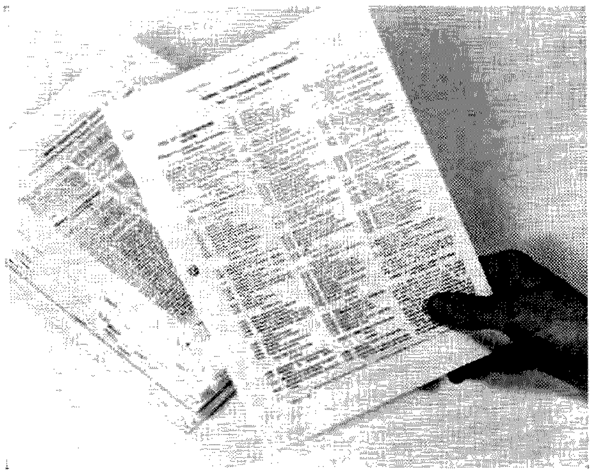


Fig. 5

game for knowledgeable experts. One finally grasps the fact that there are a great many groups interested in spectrum. This is a simplified chart-for instance: under the various committees the interdepartment advisory committee has 13+ member groups, the telecommunication planning 20+ and the telecommunication advisory board 13. There are many intricate tie-ins and delicate interrelations to consider. Our own national problem as shown is complex but when you add the international as shown on the right you complicate the problem to a considerable degree. The practical problems are real and you can put your finger on them but the intangible political and psycological problems are extremely complex. The small box indicating lobbyist is indeed a very important box.

Now lets take a look at the ITU—what is it and what does it do? Quoting from a Department of state document serial No. 384—4th revision:

International Telecommunication Union (ITU)

The Convention referred to herein is the International Telecommunication convention, Geneva 1959, which on January 1, 1961 replaced the Buenos Aires Convention, 1952. The instrument of ratification by the United States of the Geneva Convention was deposited with the Secretary General of the ITU on October 23, 1961.

Volumes of FCC Rules and Regulations by Categories

Volume I — (Aug. 1962)
- Part 0, Commission Organization
- Part 1, Practice and Procedure
- Part 13, Commercial Radio Operators
- Part 17, Construction, Marking and Lighting of Antenna Structures

Volume II — (Dec. 1961)
- Part 2, Frequency Allocations and Radio Treaty Matters: General Rules and Regulations
- Part 5, Experimental Radio Services (other than Broadcast)
- Part 15, Radio Frequency Devices
- Part 18, Industrial, Scientific, and Medical Services

Volume III — (Sept. 1961)
- Part 3, Radio Broadcast Services
- Part 4, Experimental, Auxiliary and Special Broadcast Services

Volume IV — Feb. 1962)
- Part 7, Stations on Land in Maritime Services
- Part 8, Stations on Shipboard in Maritime Services
- Part 14, Public Fixed Stations & Stations of the Maritime Services in Alaska

Volume V — (Feb. 1961)
- Part 9, Aviation Services
- Part 10, Public Safety Radio Services
- Part 11, Industrial Radio Services
- Part 16, Land Transportation Radio Services

Volume VI — (Feb. 1962)
- Part 12, Amateur Radio Service
- Part 19, Citizens Radio Service
- Part 20, Disaster Communications Service

Volume VII — (Jan. 1963)
- Part 6, International Fixed Public Radio Communication Services
- Part 21, Domestic Public Radio Services (Other than Maritime Mobile)
- Part 25, Satellite Communications

Volume VIII — (Jan. 1961)
- Part 31, Uniform System of Accounts for Class A and B Telephone Companies
- Part 33, Uniform System of Accounts for Class C Telephone Companies

Volume IX *
- Part 34, Uniform System of Accounts for Radiotelegraph Carriers
- Part 35, Uniform System of accounts for Wire-Telegraph and Ocean Cable Carriers

Volume 10 — (Jan. 1961)
- Part 41, Telegraph and Telephone Franks
- Part 42, Preservation of Records of Communications Common Carriers
- Part 43, Reports of Communication Common Carriers and Certain Affiliates
- Part 51, Occupational Classification and Compensation of Employees of Class A and Class B Telephone Companies
- Part 52, Classification of Wire Telegraph Employees
- Part 61, Tariffs
- Part 62, Applications to Hold Interlocking Directorates
- Part 63, Extension of Lines and Discontinuance of Service by Carriers
- Part 64, Miscellaneous Rules Relating to Common Carriers
- Part 66, Applications Relating to Consolidation, Acquisition, or Control of Telephone Companies

Fig. 6

The International Telecommunication Union (ITU) is an international organization established for the purpose of coordinating international telecommunications of all kinds. It operates principally through conferences, meetings, an Administrative Council and a secretariat and by correspondence. Its seat is located in Geneva, Switzerland. It is the specialized agency of the United Nations concerned with telecommunications. As of this date, it has 122 members and 2 Associate members. The membership is increasing steadily and rapidly as the new countries of Africa join the Union.

The Plenipotentiary Conference is the supreme organ of the Union. It deals with the basic principles underlying telecommunications, and with administrative, budgetary and personnel questions, as outlined in Article 6 of the Convention. Its decisions are embodied in a convention or treaty. It can amend, revise, set aside or change the decisions of the Administrative Council, other organs of the ITU and any of the other conferences or meetings, or of the Secretary General. It meets normally at a place and date decided on by the previous Plenipotentiary Conference and the delegates have full powers to sign a treaty or convention, which, in the case of the United States, must be approved by the Senate and ratified by the President.

The 1962 report published in 1963 lists 328 persons employed—excluding staff engaged on short term contracts. Of the above 16 were elected officials, 242 permanent office holders with contracts and 70 holders of fixed term contracts.

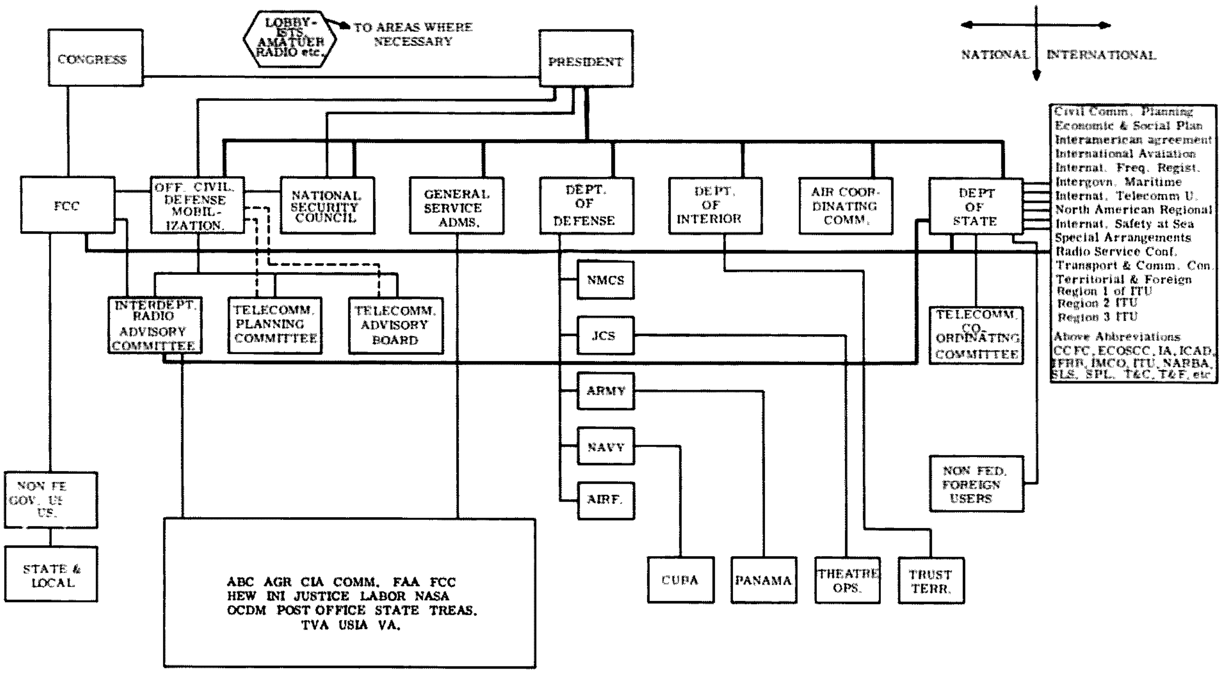


FIGURE 7

The chart Figure 8 shows the 1965 plenipotentiary conference that will affect ham radio.

There are several types of conferences convened by the ITU. Articles 6 and 7 of the Convention describe them and set forth the procedures for calling them. Briefly, depending on the type of conference, they may be convened by the preceding conference of the same type, or when at least twenty Members and Associate Members of the ITU have addressed individual requests to the Secretary General, or on a proposal of the Administrative Council of the ITU.

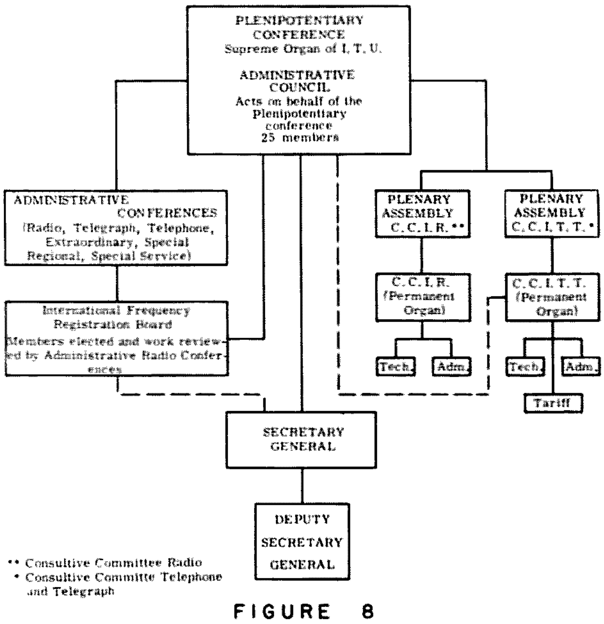


FIGURE 8

A United States Delegation for a conference is made up prior to the holding of the conference and, in general, is composed of persons from Government and industry who are familiar with the subject matter of the conference and have participated in the preparatory work.

We now have three excellent Amateur Radio Magazines to express our views. Through these mediums we can express our views and have some amount of control over the problems. They, in turn, realizing the power of the printed word will use only those things that benefit ham radio. We have too many pesudo experts who rant and rave on the ham bands (with the world listening) about a subject that is unbelievaeably complex while our competition for spectrum allocation has a group of Washington attorneys carefully studying every move and this in turn is coldly calculated and released for publicity. Other groups have taken to poison pen writing and promiscuous mailing. Still other groups, especially clubs have some very fine magazines.

We need lobbying help but there is a way to do it. We have many hams in important places —Senators, Congressmen, sons of ex presidents, high military officers and many others. By proper action the group who is presenting our case can use help—so— know your ARRL Director and see that he represents you read CQ and keep in tune with the times. So let's cooperate and preserve our bands—it is time for everyone to accept what the best minds in

radio can do for us. The die is cast for 1965 ITU—let's be sure we don't lose bands—let's gain some—with your letters and ideas to the magazines—we will have the strength of 250,000 minds welded into a single master plan to see that our wonderful, useful necessary amateur radio grows and prospers.

This is the time for QST, CQ, and 73 to do a yeoman job in presenting the best side of amateur radio.

. . . W2DUD

Club Announcements

Win A Trip to Bermuda!

Tired of contests where the only award is a fancy piece of wallpaper? The Bermuda Amateur Radio Contest offers first prize of an airline round trip to Bermuda for two plus a week at Carlton Beach, Bermuda's newest hotel. In addition, high scorer in each U. S. and Canadian call district will receive a handsome certificate signed by the Governor of Bermuda. The contest will be held the weekends of May 2, and May 16, and is for single operator phone or CW stations on 80 through 10 meters. Log sheets and complete rules can be obtained from the Contest Committee, Radio Society of Bermuda, P.O. Box 275, Hamilton, Bermuda.

Birmingham Hamfest

The 11th consecutive session of the Birmingham Amateur Radio Club will hold forth in Birmingham on the week end of May 2-3, 1964. The location is the State Fair Grounds.

The Southern Tier Radio Clubs of Broome County are holding their Fifth Annual Dinner on April 4, 1964, at St. John's Ukranian Hall, Virginia Avenue, Johnson City, New York. Doors open at 5:00 p.m.; dinner will be served promptly at 7:00 p.m. Tickets are $3.50 per adult and $1.75 per child under 12 years of age; reservations must be made by April 1. For tickets write **Harry Spencer, 1165 Vestal Avenue, Binghamton, New York.**

Letters

Dear Wayne:

Please excuse the league stationery but I want to use it up as fast as possible—I may be ashamed to use it at all one of these days if the little people of Newington keep having their way.

I have been a loyal ARRL member ever since I started in ham radio in 1958 at age 47 to satisfy a need for an absorbing hobby following a coronary the year before. Upon getting my general license I immediately dedicated a substantial portion of my available time to serve my community with the new privilege which I had earned the hard way with no technical background. I joined the Wayne County RACES organization serving as assistant zone officer, zone officer and now assistant county officer. I have served in many other ways, such as handling traffic for our service men overseas, relaying emergency messages, etc. I have sent important news messages via radio teletype, for example, my own TV-eye witness account of the shooting of Oswald sent to the S. S. Hope minutes after event, etc. On the technical side, my son, K8JND, and I designed and built a RTTY TU with image inversion and flip-flop section that performs as well as any that I have seen yet. I have some store equipment and I have built about fifteen kits but I have many other things that I and my son have built and developed on a strictly home brew basis with due regard to our gradual self acquired technical knowledge. I believe that, although still not fast at cw, I am a good operator.

With that background, plus a substantial professional education in other fields, I feel that I have the capacity to reach fair conclusions concerning the relative value of organizational endeavors on the part of others who purport to represent the amateurs of the United States. Up to a certain time last year, I continued to support the ARRL in every respect. I sought new members and contributed to the building fund. When the question of incentive licensing came up I considered the matter seriously, not necessarily from my own personal point of view, but from the angle of every ham I knew. I talked with others, young and old, technically inefficient and proficient, and I came to the conclusion that perhaps some form of incentive licensing might be good for the long pull by increasing the requirements of the present examinations but realizing, of course, that technical upgrading alone will never solve the purely operating problems. Some of the most insolvent and provocative hams I know or encountered are so-called old-timers obviously possessing some degree of technical skill but lacking in decency and let's call it amateur "civil rights."

Well, to shorten the story, when I discovered that the ivory tower boys were trying to make a case for license degradation under the guise of the absolute need for mass education I began to think of the injustice to even a minority who deserve and paid for the protection of the ARRL—I began to think about my retired friends who have invested in equipment but through perhaps illness or age itself would be hard pressed to aspire to higher technical demonstration—for what—just to keep their present status. On the other hand if the examinations were only multiple choice questions easily mastered by memorization without the need for sound basic education, what good would the upgrading do in the long run?

Naive as I was I believed that the ARRL would not even consider the question any further if even a substantial minority felt the unfairness of a degradation proposal. When I saw that the wind was blowing in the wrong direction through QST editorials and numerous articles and speeches by a handful of professional technicians posing as true amateurs, most of whom, you can bet, got their education and technical backgrounds at the taxpayers' expense either in the service, by G.I. bill or with some government contractor, I finally decided to write a personal letter to each ARRL director and vice-director and our honorable league president to alert them to the pressure that was going on. I made it clear that what I was opposed to was simply the downright degradation and not to incentive itself. Furthermore, I proposed a simple and reasonable solution which has been the basis of upgrading every license privilege since Kingdom Come. A copy of my letter is attached. As you will note it was mailed a few weeks before the fateful "unanimous" decision. For all my trouble, I received a reply from one West Coast director who said it was a fine idea. My own director or vice director did not show the courtesy of even a post card reply, nor did I get a peep out of the president or the little people at headquarters, nor was my letter published or mentioned anywhere. As far as I could see the only negative letters published were bitter and uncompromising in nature, presumably to make sure that most of the membership would feel that these objectors were rabid reactionaries who probably didn't deserve a general ticket in the first place.

I have to admit, Wayne, I used to think you were a screw-ball for taking perhaps somewhat violent stands on various controversial subjects. Maybe you still are, but I have been following you closely on this licensing question and you are right in their pitching for everyone of us and you are right in there pitching for everyone of us whether we like it or not—and I like it.

So, before the little men at Newington decide to disclose any of their other nine points of progress, here is my ten dollars for the Institute of Amateur Radio and let's get with it and a sound and sane representation of all of us who want to protect our beloved avocation from without and within.

Good luck, Wayne, and may the organization rise to the occasion under your leadership.

73

Sincerely Yours,
Everett M. Hawley, Jr.
K8JTT

Dear Mr. Green:

I wish to take this time to compliment both you and your devoted staff for your excellent contributions to the field of amateur radio. During this time of divided feelings something is needed to stand fast and defend the true radio amateur. This is what you are doing. Please continue to hold your ground. There are many of your fellow hams standing behind you.

I have one suggestion in regard to the Institute of Amateur Radio. There are many college students like myself who find it very difficult to find the ten dollars to invest in the very worth while organization. May I suggest a fund for donations where hams like myself can donate whatever amount of money we can spare to support the IoAR?

73,
K8LPD/9
c/o Rose Polytechnic Institute
Terre Haute, Indiana

Dear Wayne:

Being a newspaperman as well as an "old-timer" (first ticket 1916) I am not too avid in this "Letters To The Editor" bit. But as I had occasion to write your Circulation Department anyway, thought I'd toss a bouquet at the same time.

You ARE doing a very fine job now, and have always done so, even when hamstrung by the Cowan group. Being more or less inactive (ham-wise) the past couple of years, I wondered what ever happened to "Never Say Die," and it was only within the past year I noticed "73" on the newsstands and have consequently been taking the

publication since. For your over-all information: I am (and have been for years) a member of the ARRL; I disapprove of the methods being used by the Board of Directors and/or the "Executive Committee"; and I am opposed to proposal as set forth by the ARRL. I am of the opinion that there should be and will be some changes made in the license structure, but the "Proposal" isn't it!

As a newspaperman, I like your approach to the entire question, by not going off half-cocked, but rather reviewing the pros and cons of all the facts that can be associated, or affect the proposition in judgment.

R. A. Pedersen, W7FBL
Fallon, Nevada
(formerly: 9NX 9CDN W9FBL K6ZFW W7FBL.)

Dear O.M.:

I am enclosing a copy of a letter to the ARRL, which you will see by the date was sent to them at the beginning of their Guerilla Warfare. Today, February 29, marks the end of my membership in the ARRL, I do not intend to renew, for I feel that they do not represent the wishes of the Ham fraternity. And, I know of many more Hams that are going to take the same action, many have already done so.

It is my opinion that the whole mess is without reason. Why?, at this late date must the Hams suddenly be upgraded? All the past years should have been used to upgrade the dignity and consideration for the Hams around the world, this has not been done. All through history and in all endeavors, some bright boys have always moved in with schemes to divide and conquer, always with the theme that they are doing it for the good of the people, who are being deprived of their rights. Could it be that some bright boys have moved in to headquarters and are stirring up this mess so that in the melee, the Hams will be so badly disorganized, that some special interests can pirate some of our bands? Anyone with an ounce of grey matter can see that the whole mess is outrageous.

I was a Ham back in 1908, I have a grandfather's right to an Extra License ,but haven't felt that I should go to the trouble to get it at my age.

Thank the Lord that all through history when a crisis develops someone stands out above all to carry on the fight, it looks like you are the one this time.

I was a charter member of tht old National Amateur Wireless Association. This group and Hugo Gernsback, Major Armstrong, DeForest and many others saved amateur radio when we were supposedly sent down to below 200 Meters, in the rat hole. The amateurs dug their way out with startling results.

Later, Mr. Maxim came up with the idea of Hams relaying messages from point to point, this caught on like wildfire and was the birth of the League. Naturally Mr. Maxim wanted to control his child, and he did a good job, but before he passed over the torch, he should have reorganized, which is the thing he would have done to a personal fortune.

The members are the stock holders, they should elect the Pres'., V. P., and the board of directors. A financial statement should be published yearly, the same as a corporation has to do. A summary of salaries paid and traveling expenses should also be available to any member who asks for it. A complete reorganization is definitely in order, but how can it be done?

I predict that the FCC will turn down this proposal with a Bang! They have done a good job in the past, and I can not bring myself to believe that they will go back on the great Wisdom that they used in 1952.

I would think that the equipment manufacturers would rally behind you in a big way, after all they will be the big losers if this is put over. The league is not "Sacrosanct."

I hope that I have not bored you wtih my Personal Opinions, I am just an old timer, who wanted to get it off his chest.

Paul J. Rasmussen K7EML

The Vertical J

a simple, inexpensive six meter antenna

Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

Having trouble working 6-meter mobiles who're using whips, with your home-station beam?

Or maybe you're interested in an omnidirectional antenna for CD net use which you can put up or take down in a heck of a hurry?

Or maybe you just want a simple and inexpensive skywire for Six, which you can put together in a very few minutes and which will perform excellently (although admittedly, it's *not* in the same league with a 4-element or bigger beam).

If any of these situations fit you, you might consider using a vertical J. That's what we call it in the Midwest, although the fellows out in 6-land know the same antenna as "the grounded J." This is a simple, fast-to-build antenna which meets all the needs outlined above.

This is *not* a radical new antenna. Its basic principle has been included in the VHF antenna portion of every ARRL handbook I have ever seen, all the way back to the 1943 edition. But this is a case of something being so old it's new again!

Around Oklahoma City, the first vertical J went up something like four years ago (naturally, I mean the "first" of the new generation). It took quite a while to catch on—but today more stations are equipped with Js than are not.

Which isn't saying that Okla. City is a vertical area, for it's not. Many if not most of the J-equipped stations are also equipped with beams. The J is used for local net work and ragchewing with mobiles; the beams come into play when DX is available or when extended groundwave is the object.

So what is this device? Fig. 1 shows what it looks like; the long element is ¾ wave long while the shorter one is ¼ wave. In essence, this is an end-fed half-wave, using a shorted quarter-wave section of parallel transmission line (the lower sections) as an impedance transformer. While it's possible to feed it directly with 50 ohm coax by connecting the shield to the grounded strap across the bottom and tapping the inner conductor several inches up either element, the preferred feed method is shown in Fig. 2—a half-wave "trombone" balun to provide 208 ohm balanced feed, which is then tapped up both elements at the proper point.

Where is this "proper point?" It will depend to a large degree on just how you put the antenna together; best practice is to determine it with the aid of an SWR bridge as will be explained later, but it's usually within 6 inches of the bottom.

Before we look at some more-or-less detailed construction data, let's examine the advantages and disadvantages of this antenna. On the advantage side you have omnidirectional pattern resulting from the vertical polarization; lack of cross-polarization loss when working to whip-equipped mobiles; ease of construction; and positive grounding if recommended construction practice is followed. On the disadvantage part of the ledger you find the introduction of cross-polarization when working horizontal stations, and lack of any antenna gain (although this antenna is usually credited with 3 db gain over a ground plane, for no tenable theoretical reason that I have been able to locate).

If you want one of these, at this writing, you'll *have* to build it yourself since no one I know of makes a commercial model. This, however, is not hard to do. Start out with a long

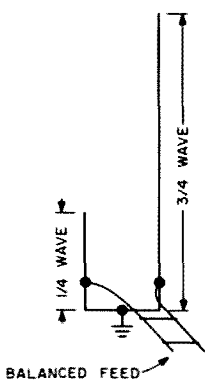


FIGURE 1

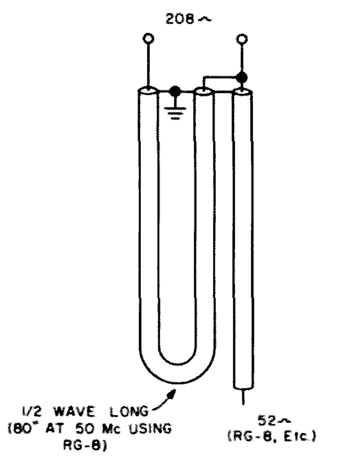


FIGURE 2

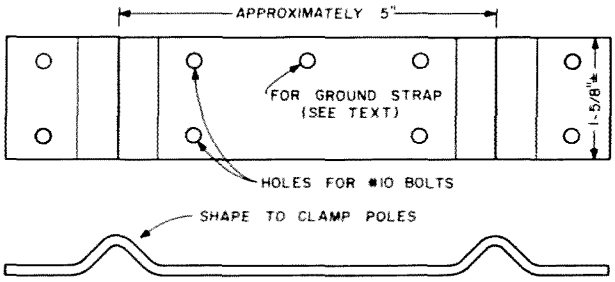


FIGURE 3

supporting mast. Telescoping TV poles will do. Extend the top end of the mast the required ¾ wave distance above the upper guying point. This will be approximately 15 feet, requiring a 5-foot extension if you use a telescoping stick.

Shape two straps similar to Fig. 3 from ⅛ inch aluminum (a 1¾ inch relay rack panel comes in handy as a source of raw material at this stage) and bracket the quarter-wave element to the pole just above the guy point as shown in Fig. 4. Scrape all metal surfaces clean and tighten screws fully, since this is a high-current point and any resistance will cause power loss.

Form a similar set of straps from ⅛ inch Plexiglass or Lucite. Most cities of any size at all now have plastic-sign shops which provide a source of this material from their scrap piles. To bend the plastic, soak it in boiling water until it softens and then bend rapidly, holding in place until cool. Attach this insulating bracket near the top of the quarter-

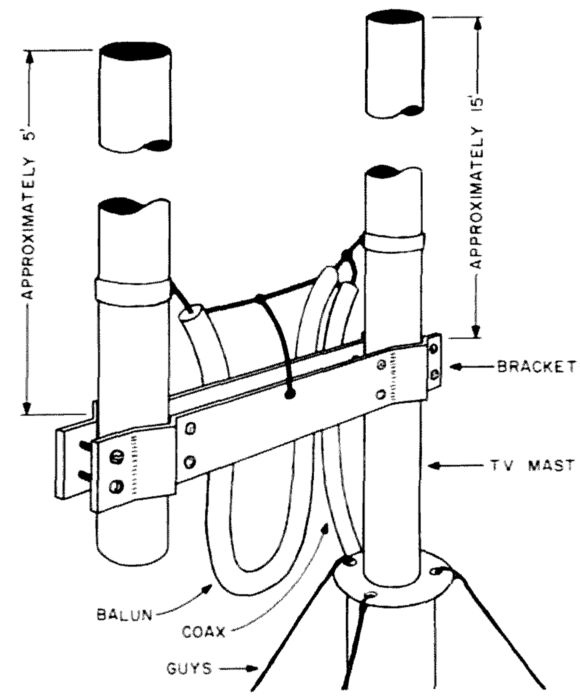


FIGURE 4

wave element to maintain spacing and to support the element.

Now prepare your balun as shown in Fig. 2, and solder each center conductor (the 208 ohm connection points) to a radiator-hose clamp of proper size to slip over the antenna elements. Slip the clamps over the elements (this may require partial disassembly of the antenna or may not, depending on your clamps. If you use the "universal" variety, no disassembly should be necessary) and tighten them just enough to hold in position but not so tight that they cannot be moved. Using strap braid or salvage shielding from a short chunk of coax, connect the common ground point of the balun assembly to the center of the aluminum bracket holding the quarter-wave element on. This provides an electrical ground at this point.

Now hoist the antenna to an approximately vertical position and feed in some rf. If you have a source of about 5 watts or less you can make adjustments with power in the line; If you use higher power it's best to turn the rig off unless you have a special fondness for rf burns. With an SWR bridge in the coax, preferably as closely as possible to the balun, slide the clamps up and down on the antenna until you get a reading of 1.0 (or as close to this as you can) at your favorite operating frequency.

The only remaining step is to tighten the clamps down firmly so they won't slide, and waterproof all connections by spraying with Krylon or similar plastic. Tape the coax to the side of the mast as you raise the antenna into position, and prepare to work the world!

If you have never experimented with cross-polarization, be prepared for a surprise. Losses due to this factor alone *can* be as great as 20 db. This means that you may find 20 db improvement on whip-equipped mobiles compared to your past results with a beam—but it also means you may find 20 db loss on halo-equipped mobiles or beam-equipped fixed stations. Strangely enough, on Sporadic-E (skip) signals the cross polarization seems to make little difference. Some theories tend to hold that polarization rotates during reflection, while others hold that most incoming skip signals are vertical. Whatever the reason, you'll have additional enjoyment on 6 meters if you put up *both* a J and a beam, with a switch to allow instant selection. And you'll almost never suffer cross-polarization loss that way, either!

Letters

Dear Wayne:

Lying on my back in a hospital bed for pretty close to a month gave me a chance to really go over the still rather numerous pieces of mail which the XYL graciously brought to me each afternoon.

With a break like this, I was able to sort from among the various pieces (including the usual "riff-raff" which we all get and resent) the items which really had "meat" in them. I kept coming back time after time to the INSTITUTE of AMATEUR RADIO which you initiated in 1962. Weighing this against what we have had in the past some 50 years in the way of amateur radio representation, it became increasingly apparent to me that very definitely a change was indicated. As I read more and more, through your editorials in "73" and the occasional IoAR bulletins, the more thoroughly I became convinced that you had a new and fresh grasp on the re-

quirements, legal and otherwise, which would serve to keep ham radio alive and active. It has becom increasingly obvious that present representation through what has become a more or less "smug" organization (ARRL) has fallen by the wayside and continues to do so. Rather than being representative of the amateur body as a whole, it has degenerated into "amateur radio for the few elite" who sit in the top spots. Perhaps a few in the upper brackets were beginning to see the hand-writing on the wall. As the saying goes, "Hell was paved with good intentions." While I have never had any particular admiration for Budlong, he did do a better job than Huntoon has been able to compete with. Being of the "old school," I still deplore the lack of leaders like Hiram Percy Maxim Jr., and Clarence Tusko. I joined the League which they established, along about 1914 and found it run honestly and with sincerity; I wish I could say so now! On the contrary, I have found it essential to send the ARRL a letter terminating my membership therein (copy enclosed for your information). I think that a very great number of their membership, has done the same.

At some instigation from the Pacific Northwest area of radio amateurs, I ran successfully for Vice-Director of this section, and served in this capacity for the full two-year term (Jan. 1, 1957 to Jan. 1, 1959). What with financial reports as well as administrative order copies, I really became appalled. When elections for Director came up, I was urged to put in my oar; (this may sound like "ego" but I don't mean it that way). I frankly refused although (maybe "ego" again) I feel that I could have probably overcome the incumbent. I wanted no part of it; I had seen enough of that kind of politics during my period of service (?) as Vice-Director! This division has gone along for way too many years with the same director who has actually accomplished nothing for the amateurs of his division. Granted that perhaps a very great deal of the fault lies with the hams themselves, as they very evidently did not tell the director what they thought; what they wanted, yet it does not excuse the director from putting his finger on the pulse of his division, which he did not and does not do, other than attending local, regional and divisional "conventions" where a lot of vocal "blow-hard" supposedly takes the place of sincere action.

Frankly, I don't like to write this kind of a letter and seldom do. It seems to be in order in this instance how-

ever, as I think that all of us, at least the majority who are dyed-in-the-wool hams, are mainly interested in preserving and fostering the grand and glorious "hobby" of ham radio. In present administrative hands (yes, I mean ARRL), it is becoming less and less of a "hobby" and more and more of a "political" issue; there is your chance to bring it back where it belongs, thru IoAR.

Sure, I know, as does every ham with a few years background, that commercial and military interests, continuing their fight of many years, are constantly trying to "grab" our frequencies. It is going to take intelligent (not political) representation for the hams as a whole, to hold together what we have; again, there is your opportunity.

I could go on and on, Wayne, and actually say little more. I think the above paragraphs express my individual feelings. I am going to add only a few words of "caution" if you want to call it that. The ARRL as we all know, after soliciting funds from any member who would stand still for it, built themselves a most impressive new headquarters building. To a more modest extent (37 room house, plus a recently acquired ten room domicile to which can be added a 5 room mountain-top VHF spot), you are dangerously approaching a parallel. Maybe you and Virginia haven't considered, and maybe frown on, a mid-continent location, but you might keep it in mind in the event of future expansion! An awful lot of hams with whom I have talked (and they've been many over the past half-century), seem to resent the idea of a ham headquartrs being way up in the northeastern part of the United States. Maybe this is a hint which will let your growth go by leaps and bounds . . . certainly the Mississippi valley for example, doesn't have much more snow, ice and unfavorable weather than your part of the country! We don't even know what snow, snow-shovels etc. are in our little ol' Pacific Northwest, but actually, you'd be better off in mid-US, administratively!

Name withheld as requested. Re our location: if anyone can come up with a place where we can get by as inexpensively as we are I'll listen. I doubt it. There are other factors too: our mountain VHF shack is virtually unique in that we can shoot a signal on any VHF band right on down to Washington; this is one of the most beautiful areas in the country; big cities and publication printers are all nearby.

ex ARRL Member

Dear Wayne:

With all the fuss and bother of moving into a new apartment I haven't been paying much attention to the licensing controversy lately, but I am enclosing $20 for your efforts in behalf of amateur radio throughout the world—with pleasure. I feel it's only a small fraction of what it's worth to me personally to keep ham radio intact as far as frequencies are concerned. I approve of your stated principles and hope they will bring our aims at the Conference to fruition.

You will notice that I have also enclosed my vote in your poll, but it's not on one of your blanks, but on some that Bill Orr printed up for the occasion, as you un-

doubtedly have heard by now. More power to him; hope he helps you get greater results than anticipated.

The last couple issues of *QST*, in small ways, appear to indicate that ARRL realizes other methods besides incentive licensing will have to be resorted to in order to insure our well-being at Geneva. I would certainly support anything they come up with, but it's a shame that there's not more of an open attempt to scrap all the old saws and get with the 20th century.

I see by *Time* magazine that you're running for Vice-President! Good luck!

Alexandria, Virginia 22311
Fred Laun, W9SZR/4

Dear Wayne,

Just reviewed Feb. CQ. Can this Trossman be for real? His editorial comment . . . "it is rumored that the ARRL is seriously considering placing a working office at Geneva" . . . is that a QST leak? A bellwether for Huntoon in payment for the long "Me Too" attitude of CQ?

As to your "up-dating program for the ARRL" . . . off hand I could write you a jillion words on the subject. One thing, long ago forgotten, is that as positions in the League open up there should be competitive bidding for such jobs from licensed members of the ARRL and a selection made by the Exec Committee, not by salaried ARRL officials **only**. Further, an immediate increase in ARRL membership dues to a minimum of $10 a year. QST should drop the monthly SMC reports under the title of "station activities" using the space for Director reports . . . when and as needed; and if not used, cut the size of QST down and thereby realize savings which should go into our Geneva defense funds. In fact, all ARRL-QST functions should be evaluated to the end of saving money and in turn building up a defense fund. Many and more items for League improvement are evident and I am sure you have adequately covered them; the above, less obvious, are sent along from recollections of motions and petitions I made when a Director.

Len Collett KZ5LC

(W2NSD/1 from page 4)

lows who haven't been following my editorials would do well to be cautious for our group is quite dedicated.

Some of the jobs to be done are: preparing copy for offset printing, making negatives and stripping them in, sorting out material for the Institute bulletin from press clippings and stories sent in by readers, keeping our Washington mailing list up to date, plus we need more help with circulation, advertising, and the preparation of articles for 73.

Salaries aren't great here yet, though they are improving. We do have one of two apartments available for families and plenty of space for single fellows or gals to room and board in. We have a lot to do and we're growing fast . . . perhaps you'd like to grow with us. Send full information on your background: schooling, all the jobs you've held draft status, when you will be available, photo, other hobbies, etc., to Ron Lyon W5WNF/1, our personnel director.

We'll have room for a few fellows this summer, but after our try last year the 73 Summer Camp will have to be on the basis of room-board and $5 a week unless Virginia puts her foot down.

Dayton April 25-26

Virginia and I are going to blast loose from Peterborough a little more this year, venturing out to a few conventions. Naturally one that we certainly don't want to miss is the Dayton Hamvention . . . I've been going there for a long number of years. This year they've finally moved their show into bigger quarters and we may just be able to move around from exhibit to exhibit. The Hamvention has been, to my mind, one of the most perfect conventions going. It has always been well organized, they've specialized in giving a multitude of smaller prizes so that hardly anyone goes home empty handed. I'm still using the Turner mike I won there eight years ago.

The new spot, Wampler's Arena, 1001 Shiloh Springs Road, will be serviced by a bus which runs every twenty minutes from downtown Dayton. They've got ten acres for cars to park . . . it probably won't get too crowded.

In addition to selling subscriptions to 73 and vending a few Radio Bookshop books, I'm on the program to answer any questions you all may have about the Institute of Amateur Radio.

If you want to pre-register drop a note to Dayton Hamvention, Box 426, Dayton 1, Ohio.

6-up

The ninth issue of 6-up is going to press now. The big feature in this issue is a construction article by Bill Ashby on his Flying Noise Lock unit which is described in theory in this issue of 73. Bill wanted us to run the circuit in 6-up exclusively in order to bludgeon more fellows into subscribing to 6-up. Laudable. I hated to see such an important breakthrough get only six thousand circulation when it should be out for everyone to read. We'll run the article in 73 next month . . . this month you'll have to get 6-up if you want the details.

More Mischief

Among the flood of publications that pour in here each month is a little satire magazine, The Outsider's Newsletter. One of the editors, Marvin Kitman, decided to enter the New Hampshire primary as a presidential candidate in the interests of a good yarn. In reading over the steps necessary I noticed that the official petition form had a place on it to run for vice president. Hmmm. There is always some crack-pot running for the presidency, but I couldn't recall any crack-pots running for vice president.

The Secretary of State of New Hampshire couldn't remember any crack-pot ever run-

ning for vice president either. Obviously a volunteer was needed for a new first.

We had quite a time getting the 100 signaturs for the petition, but we got 'em. Kitman didn't. Our primary will be March 9th and I will win, since I am unopposed. Fortunately this means absolutely nothing since the only purpose of the New Hampshire primary is to indicate the *preference* of the New Hampshire people.

When people ask me why I was running for vice president I usually explain to them that it's every red blooded American boy's dream to be president, but that it seemed to me that there was just too much politics involved in getting that job the usual way and that I thought I'd go for vice president, a job no one else wants, and then sit back and wait. After all, I point out, the pay is excellent, you get lots of free travel and you aren't too pressed unless the president gets a bad break. I tell 'em all this with a straight face and they seem to believe me . . . trusting folks up here.

I have, for those of you who do not take life too seriously and whose tongue is still flexible enough to fit in your cheek, some nice bumper stickers saying GREEN FOR VICE PRESIDENT. A stamped self-addressed envelope and I'll send you along a couple for your car. They're special ones that will peel off without difficulty in case you change your mind. A couple thousand of these around the country will drive the professional politicians out of their minds. It's a worthwhile cause, isn't it?

Swampscott May 9-10

This is the largest hamfest going. There are so many fellows here that you can go for two days talking to friends and still miss seeing people. They'll have plenty of exhibits, contests, talks, demonstrations, and entertainment. Tickets are $3 before April 19th, banquet $5.50. Send $$ to John McCormick W1KCO, RFD #1, Berkeley St., Tauton 1, Mass. Virginia and I and the whole staff of 73 will be down for this one . . . look for us. I'm one of the speakers so have your wits sharpened and ready to ask questions on anything.

Value

One reader wrote in saying: A ham is a fellow who has an $800 transmitter, a $400 receiver, a $300 tower, a $150 beam, a $100 rotator, a $600 transceiver in his $3000 car, and won't spend $10 on the Institute of Amateur Radio as insurance that he will be able to use all this.

. . . Wayne

73 parts kits

In the interests of making home construction simpler for those readers with anemic junk boxes 73 has gathered together the parts required for building our less complicated projects. These kits are as complete as we can make them, containing good quality parts. Except where the chassis or case is integral to a unit we do not supply it. We will mention when we do supply a case or chassis. We do supply tubes, sockets, condensers, resistors, transformers, connectors, etc. The kits are kept in stock to the best of our ability, though sometimes the distributors who supply us delay us a bit.

TWO METER PREAMPLIFIER. Uses two 6CW4 nuvistors in a grounded grid input circuit (March '63 p8) and one 6CW4 nuvistor grounded grid output. Complete with power supply. Uses 50 volts on the plates for extraordinary noise figure. Full scale drilling template supplied.
W9DUT-1 .... $18.50

TRANSISTOR TRANSCEIVER. One of the most popular kits we've ever assembled is this six meter miniscule transistorized transceiver. Really works. Hundreds built. See page 8 in the May '63 issue. Five transistors.
K3NHI $25.00

CW MONITOR. Connects right across your key and gives you a tone for monitoring your bug. Page 44, June '63.
WA2WFW $4.25

TWOER MODIFICATION. Increase your selectivity considerably by installing a new triode 7587 nuvistor stage. This is our best selling kit to date. Everything you need for the modification is included. See June '63 page 56
K6JCN $6.50

SIX METER CONVERTER, DELUXE. 6EW6 low noise front end, 6U8 oscillator and mixer. Output is 10.7 mc (easy to change to suit your needs). This is a tunable converter with fixed frequency output, not the usual converter that requires you to tune the receiver. This helps considerably on eliminating interference from nearby high power stations. See page 8, July '63.
W9DUT-2 .... $20.00

NOISE GENERATOR. Invaluable test instrument for tuning up rf stages, converters, etc., voltage regulated by a Zener diode. Kit includes even the battery and mini-box. See page 15, Aug. '63.
K9ONT $5.00

QRP TRANSMITTER. Have fun with this little one half watt CW rig on 40 meters. Uses any 40M surplus crystal. Kit supplies 1S4 tube and socket, condensers, resistors, coil, rf choke, terminal trip, etc. Runs from flashlight battery for filament and portable radio 67½ volt B-battery. See March '63 p22
W1MEL $6.00

CAST IRON BALUN. Eentsy balun using ferite core, covers 6-40 meters, will handle up to 20 watts, complete with cabinet, connectors, etc. See September 1963 page 8.
W4WKM-1 .... $3.00

TONE MODULATED CRYSTAL STANDARD. Uses one tube and one mc crystal to generate 1 mc markers all the way up through 225 mc. The built in tone generator makes it possible to easily identify the markers. Including Minibox, tube, vrystal, etc. See Oct. '62 p 26.
W9DUT-3 .... $12.95

TRANSISTORIZED MODULATOR. 40 watt modulator, excellent for plate modulating mobile rigs, four transistors, uses 12 volts dc, only draws 250 ma while resting with peaks of 4-5 amperes. Kit includes transistors, transformers, resistors, condensers, etc. See Sept. 62 p 24.
VE7QL $27.50

SHORT WAVE CONVERTER FOR HAMBAND RECEIVERS. One tube short wave converter so you can tune SW broadcast stations. Power supply included. See Aug. 62 p 38.
W2LLZ $13.00

RECEIVER-DECEIVER. Substitute local oscillator for your receiver for sideband reception, complete with power supply, tubes, voltage regulator, etc. See Jan 64 pg 30.
W2RWJ $19.95

HAM BAND AUTOMOBILE CONVERTER. Listen to the hambands instead of that rocky-roll junk. Transistor converter, complete with battery, etc., mini-box, coax cables, crystal for either 20M or 75M. Crystal controlled. See Jan. 64 pg 36.
VE2AUB $7.95

WRETCHED K2PMM

BADGES $1.00 each.

Individually engraved badges: $1.00 Room for first name and call, 3" x ¾", with pin and safety lock. Specify whether you prefer red with white letters or black with white letters.

BADGES FOR CLUB MEETINGS & HAMFESTS

Club badges 3" x 1" with name or initials of club on one line and first name and call on second, in groups of five or more: $1.50 each.

Order from

73 Peterborough, N. H.

OTHER 73 BULLETINS AND BOOKS

6UP Magazine. Now in its fifth month with back issues getting rarer and rarer. This VHF monthly magazine is edited by Jim Kyle K5JKX and presents up to the minute reports on activities on all VHF and UHF bands, technical articles of interest to VHF'ers, and other general information not to be found elsewhere. This is the only strictly VHF magazine being published now. If you are a VHF'er you won't want to miss a single issue of 6up . . . you should support it. Subscriptions are only $2 per year, back issues are available at present for those who would like a retroactive subscription.

ATV Bulletin. In direct refutation to the ARRL claim that amateurs are lagging technically are the 2000 readers of the semi-monthly Amateur Television Experimenter Bulletin, edited by W0KYQ. If you are at all interested in amateur television you should subscribe to ATV, the only source of operating and technical info on this amazing branch of our hobby. Back issues are virtually all sold out, so don't put off subscribing. $1 a year for six issues.

Ham-RTTY. This is the most complete book on the subject. Written for the beginning TT'er as well as the expert. More complete and authoriative than books at twice the price. Pictures and descriptions of all popular machines, where to get them, how much, etc. $2.00

Bound Volumes 1, 2, 3. Complete library volume containing the 1962 issues of 73. $15.00

Binders. Bright red leather binding. Specify which year you want stamped on them: 60-1, 62, 63, 64. Darbs. $3.00 each

Care and Feeding of Ham Clubs—K9AMD. Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. $1.00

Simplified Math for the Hamshack—K8LFI. This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of understanding basic math our kids would have a lot less trouble. 50¢

Index to Surplus—W4WKM. This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. $1.50

Ham-TV—WØKYQ. Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. $3.00

Surplus TV Schematics. You can save a lot of building time in TV if you take advantage of the real bargains available in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. $1.00

AN/ARC-2 Conversion. This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. $1.00

AN/VRC-2 Conversion. Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. $1.00

Coils—K8BYN. Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. 50¢

CW—W6SFM. Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. 50¢

3D Map of World. Maybe you've been eating your heart out for one of these beautiful relief maps after seeing one at a friend's shack. Comes complete with one year subscription or extension to 73. $9.95

3D Map of U. S. Complete with one year sub to 73. $9.95

Mickey Miker—WØOPA. Complete instructions for building a simple precision capacity tester. Illustrated. 50¢

Frequency Measuring—WØHKF. Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. $1.00

Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

Radio Bookshop

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

13—REFERENCE DATA FOR RADIO ENGINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

21—VHF HANDBOOK—Johnson (W6QKI). Types of VHF propagation, VHF circuitry component limitations, antenna design and construction, test equipment. Very thorough book and one that should be in every VHF shack. **$2.95**

22—BEAM ANTENNA HANDBOOK—Orr (W6SAI). Basics, theory and construction of beams, transmission lines, matching devices, and test equipment. Almost all ham stations need a beam of some sort . . . here is the only source of basic info to help you decide what beam to build or buy, to install it, how to tune it. **$2.70**

23—NOVICE & TECHNICIAN HANDBOOK—Stoner (W6TNS). Sugar coated theory: receivers, transmitters, power supplies, antennas; simple construction of a complete station, converting surplus equipment. How to get a ham license and built a station. **$2.85**

24—BETTER SHORT WAVE RECEPTION—Orr (W6SAI). How to buy a receiver, how to tune it, align it; building accessories; better antennas; QSL's, maps, aurora zones, CW reception, SSB reception, etc. Handbook for short wave listeners and radio amateurs. **$2.85**

Car Plates

Sixteen states have only one plate this year . . . this is a good time to put a call letter license plate on the front of the car. Specify color of background, color of call, and wording for the bottom line. **$3.00**

37—101 WAYS TO USE YOUR HAM TEST EQUIPMENT—Middleton. Grid-dip meters, antenna impedance meters, oscilloscopes, bridges, simple noise generators, and reflected power meters are covered. Tells how to chase trouble out of ham gear. 168 pages **$2.50**

26—59 SIGNALS—Orr (W6SAI). A manual of practical detailed data covering design and construction of highly efficient, inexpensive antennas for the amateur bands that you can build yourself. **$1.00**

27—QUAD ANTENNAS—Orr (W6SAI). Theory, design, construction, and operation of cubical quads. Build-it yourself info. Feed systems, tuning. **$2.85**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESIGNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

63—GE TRANSISTOR MANUAL—6th edition. This is one of the best buys around: 22 chapters, 440 pages, diagrams by the gross, data, facts, charts, etc. If you don't have this one you just aren't up to date. only **$2.00**

SPECIAL SPECIAL SPECIAL

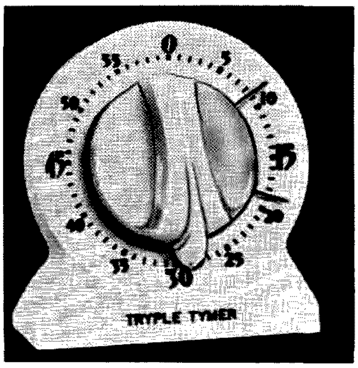
Radio Handbook, 15th Edition, written by Bill Orr W6SAI, over 800 pages. Covers every phase of amateur radio from the very basics right up through the construction of just about everything you could want in ham gear. Originally published at $8.50. Superceded by the new 16th edition which is the same except for new construction projects and selling for $9.50 (see number 11). Special, until the last few copies are gone, only **$5.95!**

100—ELECTRONIC CONSTRUCTION HANDBOOK by W8MQU. Covers all sorts of info on how to build. **$2.95**

104—SCIENCE HOBBIES—Eleven American made semiconductors with instructions for making an automotive tachometer, a photocell light meter, a transistor preamplifier, an audio oscillator, a transistor regulated power supply, speech clipping, cathode biasing and screen biasing circuits. A $29.95 value **$2.98**

107—THE AMATEUR RADIO HANDBOOK—Published by RSGB. This is a thorough and complete 540 pages handbook which covers every aspect of amateur radio: tubes, transistors, receivers, transmitters, VHF gear, sideband, FM, antennas, mobile gear, noise, power supplies, and much, much more. You'll find this one suite interesting and informative. **$5.50**

108—RADIO DATA REFERENCE BOOK—Published by RSGB. This contains all of the formulas that you have to hunt around for when you want them, all in one place and indexed. There are such items as feedline charts, coax tables, yagi measurements, pi-net charts, wire tables, conversion factors, logs, thread sizes, reactance charts, filter design charts, etc. **$2.25**



116—TRIPLE TIMER. Works like regular kitchen timer except dings at three separate times. Fine for 10 minute reminders. Set once and it will ding every ten minutes for 30 minutes. Many other uses. Can be set to ring at any time intervals up to full hour. **$4.95**

109—AMATEUR RADIO TOWER INSTALLATION INFORMATION—published by Rohn. Nearly 100 pages of info on selecting, buying and setting up towers for amateur radio. While this book is one of the most complete catalogs of Rohn towers ever published, it also has all the instructions you could possibly want on installing your tower. Lots of good color pictures. Well worthwhile. **$1.25**

112—COMMUNICATIONS RECEIVERS—Design considerations and a practical design for radio amateurs. Nicely written 32 page book discusses various stages and presents a fine receiver design for home building using regular commercially available parts. **75c**

113—TRANSISTOR RADIO HANDBOOK—Simplified theory and many ham construction projects, including SSB exciters, SSB transceiver, VHF xmtrs and rcvrs, etc. **$5.00**

114—RSGB BULLETIN—One year subscription to the most popular amateur radio magazine in England. Top notch. **$5.00**

ARC—PRACTICAL HAM RADIO PROJECTS—W6NJV. Complete construction details on 12 projects, including a 500 watt all band linear, all band antenna tuner, electronic keyer, 6 M mobile xmtr, 2M superhet, transistor dipper, etc. **$2.50**

HTF—ELECTRONIC TABLES AND FORMULAS. New revised edition. 192 pages of info. Hard bound book. **$3.95**

SSH5—TRANSISTOR SUBSTITUTION HANDBOOK, 5th EDITION. With over 5000 different type numbers of transistors what do you do when one g west? You look up the nearest replacement you have on hand in this book. It lists foreign transistors too. Very thorough. **$1.95**

RSG2—NORTH AMERICAN RADIO-TV STATION GUIDE, 1964 EDITION. All stations listed by call, frequency, and location. Over 5000 AM, 1500 FM and 1000 TV stations. **$1.95**

CBH2—CITIZENS BAND RADIO HANDBOOK, 2nd EDITION. All the latest equipment, operating techniques and requirements, antennas, maintenance, adjustments, etc. Complete rules, call area map. **$2.95**

Send check or M.O. to:
Radio Bookshop
Peterborough
New Ham Shire

Propagation Chart

April 1964

EASTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	14	14	7	7	7	7	14	14	21	21	21*	21*
AUSTRALIA	14	14	7*	7	7	7	7	7*	7*	7	14	14
CANAL ZONE	14	7*	7	7	7	7	14	14	14*	21	21	21
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	7	7	7	7	7	7	14	14	14	14
INDIA	7	7	7	7	7	7	7*	14	14	14	14	14
JAPAN	14	7*	7	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7*	14	14	14	14	14
PHILIPPINES	14	7	7	7	7	7	7	7	7*	7	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7	14	14	14	14*	14*	14*	14
U.S.S.R.	7	7	7	7	7	7	7*	14	14	14	14	7

CENTRAL UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7	7*	14
ARGENTINA	14*	14	7	7	7	7	14	14	14	21	21	21*
AUSTRALIA	14*	14	14	7	7	7	7	7*	7*	7	14	21
CANAL ZONE	21	14	7	7	7	7	14	14	14	21	21	21*
ENGLAND	7	7	7	7	7	7	7	7*	14	14	14	7*
HAWAII	14	14	14	7*	7	7	7	7	14	14	14	14
INDIA	7*	7	7	7	7	7	7	7	7*	7*	7*	7*
JAPAN	14	14	7	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	7	7	7	7*	7*	7	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14*
SOUTH AFRICA	14	7	7	7	7	7	14	14	14	14	14	14
U.S.S.R	7	7	7	7	7	7	7	7	14	14	7	7

WESTERN UNITED STATES TO:

GMT-	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7*	7	7	7	7	7	7	7	7	7*
ARGENTINA	21	14	7*	7	7	7	7	14	14	14	21	21*
AUSTRALIA	21	21	14*	14	7	7	7	7	7*	7	14	21
CANAL ZONE	14*	14	7*	7	7	7	7	14	14	14	14	14*
ENGLAND	7	7	7	7	7	7	7	7	7	7*	14	7*
HAWAII	21	21	14	14	7	7	7	7	14	14	14	14*
INDIA	14	14	7*	7	7	7	7	7	7*	7*	7*	7*
JAPAN	14	14	14	14	7	7	7	7	7	7	14	14*
MEXICO	14	14	7*	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7	7	7	7	7*	7*	7	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7	7	7	7*	14	14	14	14
U.S.S.R.	7	7	7	7	7	7	7	7	7*	14	7	7

Good: 8-9, 15-16, 19-20, 25, 26-28

Fair: 1-2, 10, 13-14, 17-18, 29-30

Poor: 3-7, 11-12, 21-24

J. H. Nelson

*** Means next higher frequency may be useful.**

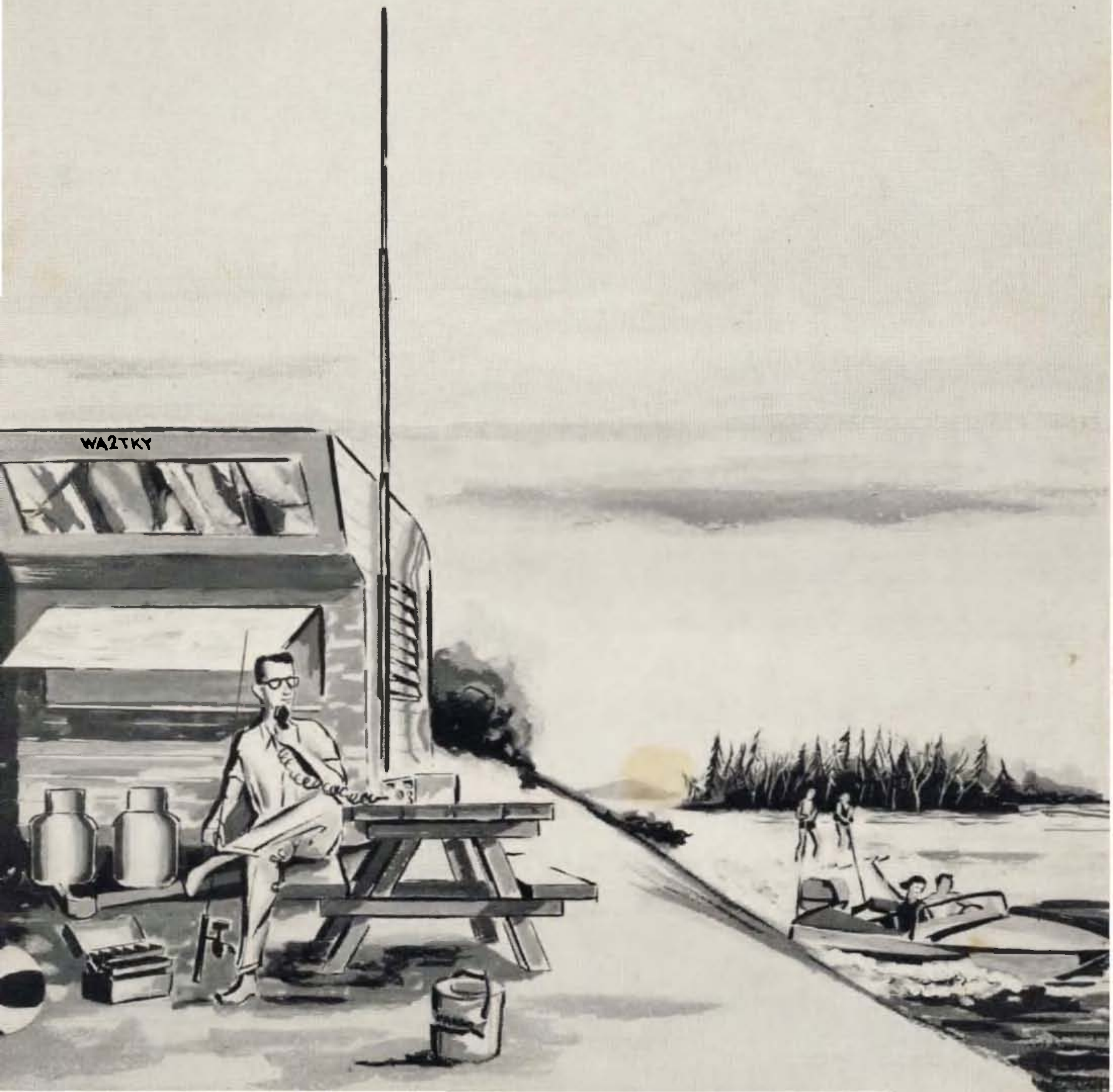
East coast to West coast, same as to Mexico.

West coast to East coast, same as to Puerto Rico.

73

May 1964
Same Old 40c

Amateur Radio



73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

May, 1964

Vol. XIX, No. 1

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates have just been hiked (after considerable warning) to $4.00 per year, $7.00 for two years, $10 for three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the U.S.A. Entire contents copyright 1964 by 73, Inc. Postmaster: please send form 3579 to 73 Magazine, Peterborough, New Hampshire.

de W2NSD/1

never say die

Why Johnnie Can't Read

It's too painful. I can sympathize with John's problems. It must really bug him to get erudite letter after erudite letter telling him and the ARRL off, each with that little "cc to 73" at the bottom. I'll try to bring you little samples of the mail that somehow never makes it into QST in our letters department.

I understand that at a club meeting down in New Jersey in mid March, attended by Huntoon, a "League Official" publicly doubted the validity of the 73 poll of amateur opinion on RM-499. Johnnie, stop deluding yourself. The results of the poll are accurate and you *know* it. It doesn't seem possible that even wishful thinking could put that nagging figure of 80% opposed to 499 out of mind. Not only did the 73 poll give this figure, but we find the same proportion when we examine the FCC files on 499 in Washington. The mail received provides a similar tally, as do polls at hamfests where a count is taken without a Hoover brainwash.

Johnnie, even the polls being taken by your own Directors are giving you almost the same results (which you don't dare publish in QST). Wake up old boy. Don't try to sell us that 50-50 jazz, we all *know* it isn't so.

Johnnie, why don't you send Dick and a helper up here to count the ballots. I'll provide gas money round trip for them (from Connecticut) plus room and board while they are counting . . . (limit 30 days room and board to this offer). They will be provided all of the ballots we're received, our capitulation sheets, computer, a card table, and two camp chairs. We hope they'll be up for a visit and bring along a list of all of the chaps that they know of who have sent in favorable ballots to check against our ballots. They're all here, every last one of them . . . and a pitful few favorable votes there are.

World's Fair

The World's Fair in New York is an obvious place to show off our great hobby. Here is a place where we could show millions of people, including in all probability, virutally every foreign dignitary in the world, the value of amateur radio to our country. What a marvelous place to display evidence of the equipment we can design and build for ourselves, evidence of our unique ability to perform public service, and our ability to bring the world together through people-to-people communications.

Huntoon . . . front and center for a couple questions.

Johnnie, who, exactly made the arrangements for the exhibit? Who called Coca-Cola and suggested the exhibit? Who decided, and what influenced him to decide, that this exhibit would not contain one single item of home constructed equipment? Why have you decided to install a complete "appliance operators" setup? How did you manage to con the trusting clubs of the Hudson Division into agreeing to man this completely commercial installation? How are you going to explain this to your Directors this month? Will they accuse you of hypocrisy for talking technical achievement on the one hand and then pushing commercial equipment when it comes to a show down? Will they wonder why the equipment of one single manufacturer was chosen instead of using a cross section of several manufacturers? How will you explain this decision to all of the other manufacturers?

ARRL Fights Back

Since I have been sorely vexing the ARRL of late I naturally expected some sore vexation in retribution. The S. V. has arrived. "73 Magazine is not acceptable as an exhibitor at the 1964 ARRL National Convention." My vex is very sore. It fair brings tears to my eyes

when I think of the tens of loyal ARRL camp followers who will be robbed of their golden opportunity to spit epithets in my face. My heart renders when I think of the hundreds of dollars we will save in not driving all the way down to rotten old New York in the middle of ghastly August. I tremble in dismay when I think of the poor families of those gouging porters who take hours to carry a small box to our postage stamp sized $200 exhibit space . . . the one over in the corner behind the pole. Alas, I will miss those canasta games with the other exhibitors while waiting vainly for someone to come to our exhibits, even if only to try to steal something.

It is not terribly depressing, when one has completely accepted a seemingly unavoidable unpleasant fact, to suddenly be reprieved. Virginia and I had decided that inspite of the first Hudson Convention back in 1960, which we considered a fiasco, and the second in 1962, which we prudently avoided (if we are to believe the dismayed groans of some of those who did attend), that we would support the National Convention this year, even if it cost us our shirts.

If you really want to see 73 at the Convention and promise to buy a subscription, some books, or maybe an Institute membership, then first you've got to convince Huntoon to change his mind. Now I doubt if Hunty changes his mind easily, particularly when he's emotionally upset, so you'll have to be very convincing. The basic question is this: is it really fair for the ARRL to force us to save all that money by such a sneaky action?

My March editorial apparently bugged Huntoon for a mailing went out to all affiliated clubs picking out three of my hints at possible things to come, labeling them flagrant misinformation. No doubt a few clubs will dutifully pass along this letter as Gospel. It is bound to happen that some will look into 73 and see that there is a lot more flagrant information than flagrant misinformation.

Auto-Call, the club paper for 17 radio clubs in and around Washington, D. C., devoted considerable space to my editorial, including many quotes from it.

RM-499

W4TYH and K3VUQ went through the FCC files on RM-499 and reported that there were about 3000 items in nine file folders. Some were petitions, some were individual comments, others were letters of inquiry. It took all one day to sort out the mass. They found that between 80 and 85% of the amateurs

(Turn to page 85)

Bill Ashby K2TKN
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Strong Noises — Weak Signals

or

The Flying Noise Lock System

Like the weather, every one cusses noise but few attempt to do much about it, except trying to learn to squint their ears, which isn't easy.

Noise comes in various forms and intensities and it is pretty hard to find any two of the hundreds of noise definitions in print that describe the same thing.

For our purposes, let's say noise is detectable energy that never happens twice in the same place or the same way.

This lets out ignition noise, power line leaks, rotating or vibrating contact arcing; i.e.: repetitious pulse trains of wide bandwidth; for modern circuitry—noise blankers—rhododendron swamp hole punchers, etc., have pretty well settled their hash.

We are talking about electron motion noise. That non-coherent crud that is generated in infinite amounts throughout the whole galactic universe; measurable amounts when current is passed thru a hot resistor; and microwatts of which, in the input stage of any receiver, keeps us from hearing weak signals. "Johnson noise" as it is usually termed, is smooth and evenly distributed, but totally non-coherent. If a channel of 10 kc width centered at 450 kc was mixed with a channel of 10 kc bandwidth of the same shape factor but centered at 460 kc in a linear mixer the noise in each channel would neither add nor subtract, you would just get noise. The instantaneous peak value depending on the value in either channel at that instant and the gain or loss in the linear mixer.

This is an extremely controversial subject and the above definition treads on some highly educated toes, but remember nothing was mentioned about averages, non-linear detection, pre- or post-detection integration or attempting to measure finite values of noise power. All of these complicate the above picture to the nth degree and has been known to drive long friends at each other's throats with bare knuckles, knashing teeth and bloodshot eye.

Since we aren't going to discuss any of these, let alone try to use them in practical circuits, we will let the communication theory hounds worry these points into obscurity.

If you were to look at the output of one of the forementioned *if* channels with a wide-band, ultra-fast rise and fall-time scope operating well below the overload point, you would describe the pattern as very fine, continuously changing grass growing equal distances up and down. Widening the pass-band of the *if* channel would make the grass finer in changing detail and severely narrowing it would give a coarse, ever changing structure. At any instant in time it can have any amplitude, frequency or phase and it may or may not be the same at any other instant—in other words, complete non-coherence. It is extremely doubtful that noise in this state can be modulated or detected without serious changes in its basic structure.

Mixtures of very weak signal and lots of this type of noise are extremely difficult to picture. It is not really known if the noise rides on top of the signal or vice versa or whether they just intermingle. We do know that any attempt to measure or detect any part of this mixture with a non-linear or averaging circuit of any kind wipes out the smaller variations and squelches out the weak signal. By weak signal, we mean one whose peak value is 20 to 30 db under the peak values of the associated Johnson noise in the circuit. By using all linear circuits in your rcvr (product detector-BFO, etc.) CW signals that are 30 db below the peak value of the noise can be heard and with long practice slow CW can be read by a very expert ear when approximately 20 db below the noise peaks. It is doubtful that unknown signals of these intensities can be located or acquired by tuning this type receiver unless they peak up occasionally to much higher levels.

The commercials and military people have a number of systems that can pass useful information over circuits where the received signal is this far down in the noise. The majority of these are closed loop systems of

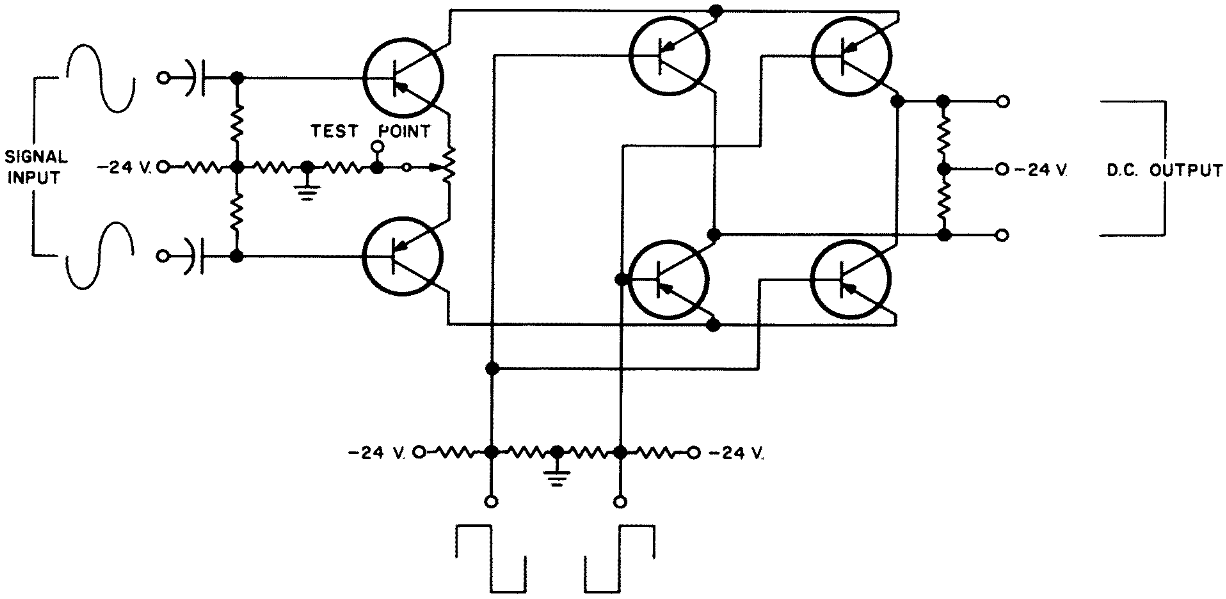


FIGURE 1

little value to independent amateur operation. In these, some definite form of information is included in the transmitted signal and the receiver does not actually detect but correlates to locate this pattern of information out of the morass of noise. Another way to describe this —a key shaped block will only pass thru a key shaped hole—the round, square, oblong and triangular ones are ignored. If the receiver knows exactly the frequency—in fact, the exact received phase of the desired signal, then digging 30 db inside the peaks of noise is no problem.

What then, could two independent amateurs, half way around the world from each other, do to realize some measure of improvement in very weak signal in the presence of strong noise reception? This might be on 20 meters when the band is dead or on 432 mc using the moon as a reflector, but we must have a channel that is free of QRM. We want to get below that weak signal threshold that is so apparent in every receiver when a weak signal fades abruptly into the Johnson noise of its front end.

Many schemes have been tried by various amateurs—use of WWV as the phase lock identification; Dicke Astronomy setups with high speed switching between antenna and controlled noise source with synchronous detection, to achieve a hair-trigger balance that nulls out all receiver noise; and the only one that has given any concrete results—fantastic stabilization of the transmitted frequency to the extent that phase coherence between it

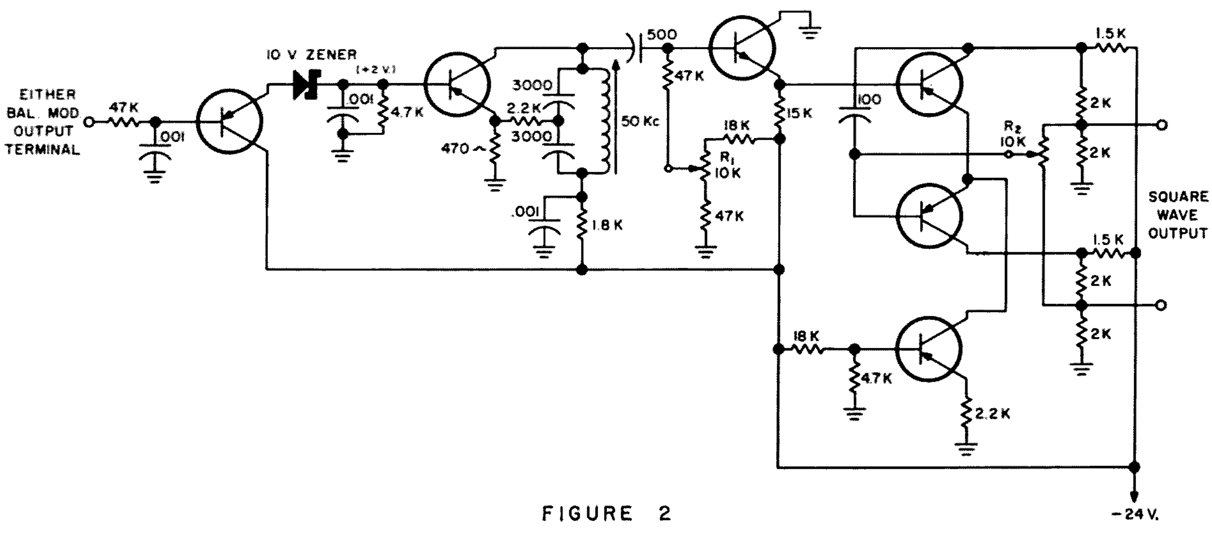


FIGURE 2

and a stable BFO could be integrated inside a human head. A number of simple and very complex open loop phase-lock systems have been attempted (AFC of the L.O. or BFO to stay in phase stable relationship to received signal) but all seem to require very strong signal peaks to lock up so aren't much good, or noise peaks kick them off the desired signal, which is disastrous.

Flying Noise-Lock System

In experimenting with many variations of a number of the above systems, it became obvious all depended on a phase detector that really was just that. It had to be linear to both signal and noise and to give output that was a true measure of phase between a known and an unknown and to reject by at least 30 db any improperly phased inputs and particularly suppress input amplitude variations for these would be primarily noise. Since inventing such a circuit could be hard work I spent some time in research (lifted the circuit from a piece of equipment designed for another purpose). This is a double-balanced modulator that really is almost idiot-proof (Figure 1).

The diagonally opposed transistors are switched on and off by the square wave reference frequency. When they are switched on they are amplifying in a linear manner during that half cycle. In this way when the incoming signal is exactly in phase with the reference, the two transistors connected to one collector load resistor draw increased current and the other two less so there is a several volt dc difference between the collector ends of the balanced collector load resistors. 180° phase difference reverses this dc difference, and random phase gives zero dc output.

Random phase relative to the references or amplitude variations at either input such as noise result in some noise output but this will be attenuated by at least 30 db if the circuit is not overloaded.

Since the phase of a desired weak signal is not known, we are going to look for it. The very weak noise output from the balanced modulator caused by random phase and noise peaks is amplified in a linear dc amplifier and applied as AFC control to the base of a transistor whose collector-emitter circuit form a reference oscillator. The output of this is fed to a Schmitt trigger to form the symmetrical square wave required by the balanced modulator. Just enough filtering time constant is used to keep the AFC circuit from oscillating, but yet allow a wide band of positive and negative noise pulses to sweep the reference oscillator back and forth at random noise rates (Figure 2).

The result is very complex but can be simply described by the apparent action. It appears to lock up on every random noise pulse that gets thru the balanced modulator. If this pulse is moving in frequency—so does the reference oscillator—locked on. During this instant there is dc output from the balanced modulator for the oscillator is either exactly in phase or out with the noise pulse and this establishes the flying lock. But a noise pulse doesn't last—it moves clear off frequency or dies in amplitude and at its AFC minimum threshold the circuit jumps to the next best noise pulse available. This may result in the oscillator locking up in the same phase or opposite resulting in dc output from the balanced modulator of opposite polarity. Because noise is completely random the output circuit flops back and forth in polarity and amplitude of dc in a totally random manner for there are are just as many flings as

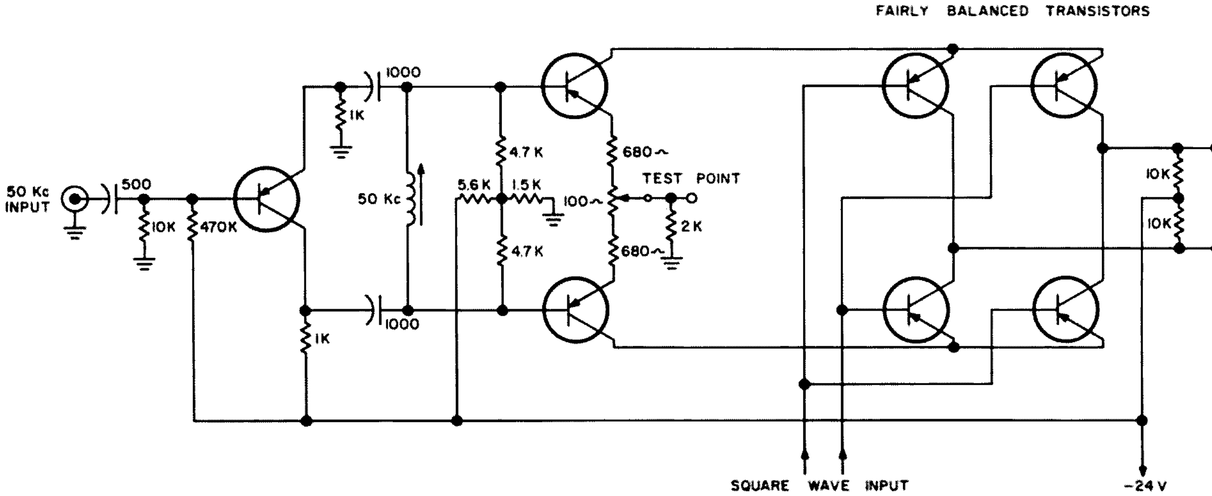
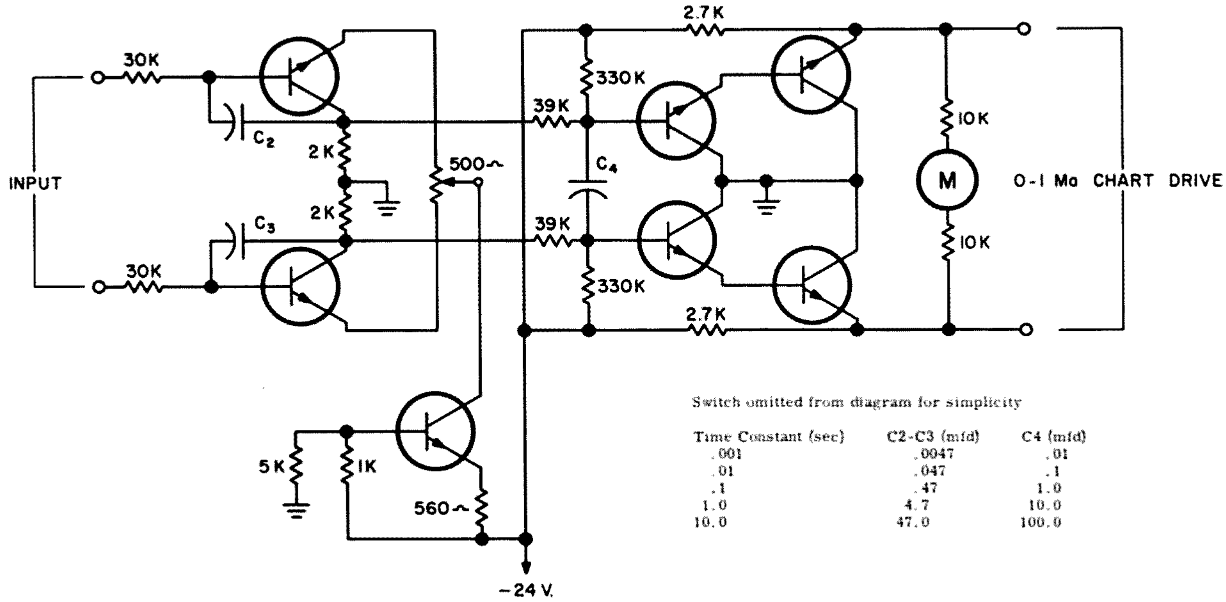


FIGURE 3



Switch omitted from diagram for simplicity

Time Constant (sec)	C2-C3 (mfd)	C4 (mfd)
.001	.0047	.01
.01	.047	.1
.1	.47	1.0
1.0	4.7	10.0
10.0	47.0	100.0

FIGURE 4

there are flangs even during a few miliseconds (Figure 3).

By means of a cathode or emitter follower, a volt or so of linear *if* signal is stolen from the last *if* in the station receiver. The BFO and all non-linear detectors must be decoupled or disabled.

This linear *if* output is fed to a split phase inverter to feed the double balanced modulator, rather than use a center tapped *if* transformer that could restrict or modify the frequency response at this point. The balanced driver transistors match the input impedance of the emitters of the balanced modulator. The total gain of these stages is not enough to produce non-coherent noise at the output without *if* input so that the reference oscillator rests on its natural frequency which should be approximately centered in the *if* passband of the receiver.

Under normal operating conditions, observation should be made occasionally with a high gain scope between the input Test Point and ground. Any evidence of signal at this point indicates severe overload of the balanced modulator and *if*-rf gain in the receiver should be reduced.

Tune the receiver across a fairly weak signal. The reference oscillator will lock up as soon as the signal is in the pass band of the *if* and balanced modulator. Several volts of dc difference is potential between the balanced modulator collector load output terminals will be in evidence. Upon tuning the signal thru the center of the *if* passband this dc output will flop to the opposite polarity as the reference oscillator locks in the opposite phase. This will hold till the signal is tuned out of the *if* passband and the reference oscillator AFC lets go and the oscillator heads for center, then random noise in the AFC loop starts the whole system searching at the noise rate again; it is looking for signal!

With very weak signals the operation of the flying noise lock system is slightly different. It will be necessary to add a high-gain, variable time-constant dc amplifier for the resultant dc shifts from weak signals may be 30 to 50 db below the peak swings from noise (Figure 4).

As outlined before, during no signal condition, the dc output from the balanced modulator flops back and forth at a random rate. By introducing longer time constants in the indicator amplifier, we can reduce the amplitude of these swings caused by short pulses of noise without interfering with the circuits' ability to indicate dc shifts that are caused by signals of longer duration than the time constant used.

Really weak signals will not indicate a locked up oscillator AFC but the indicator circuit will register more swings or "hits" toward one polarity than the other. Tuning across a very weak signal slowly will show increased hits toward first one side than toward the other as the signal modifies the phase on either side of the *if* passband.

This flying noise lock system tends to integrate hits when signal is present even in extremely small amounts. Use of some time constant in the indicator amplifier slows down the irregular swings of the output due to noise, but doesn't interefere with the output swinging over and staying there when signal is present

then going back to the irregular swings centered around zero during no signal (Figure 5).

This Schmitt trigger circuit can be used across the recorded output of the indicator amplifier. This circuit keys the relay from the differential output and this keys an audio oscillator so slow CW can be read by ear. With very weak signal there will be errors in keying caused by noise pulses but the over-all result is far better than attempting to directly read a signal buried this far in the noise. For really solid results under very weak signal conditions a pen recorder allows reliable integration of signal hits actually thru the valleys of the noise pulses.

Without signal, there should be approximately 1 volt, peak to peak, of undistorted noise (measured with a wide-band scope) at the base of the reference oscillator. Attempts to increase this time-constant, or AFC filtering, will make this system a normal phase-lock affair, with attendant poor performance in acquiring weak signals. At the same time, any non-linearity in any part of the system. Particularly before the balanced modulator will wipe out weak signals.

This system digs out the information that a signal is there—now we must teach ourselves how to use the result to efficiently communicate. There are several approaches being looked into, probably one of the best is toward the use of a digital sampling integrator circuit following the balanced modulator. Allen, K2UYH is working in this area with excellent promise.

The Flying Noise Lock system is completely and dynamically unstable during no signal conditions. But if anything shows up in the *if* passband that even is slightly coherent or that happens twice in the same way, the system locks up and narrows down. Under minimum detectable signal conditions, noise peaks kick it off but it goes right back to the signal. Without signal, tune the BFO across the noise *if* on a standard receiver—this crud is just the type of information the Flying Noise Lock system lives on. Use of phase modification information from a really good double-balanced phase detection circuit is something radically new, so don't knock it until you have tried it.

It is not possible, at this time, to plug in numbers proving just how sensitive this Flying Noise Lock system is. I do know that it will reliably indicate signals that are buried further in the Johnson noise than anything ever seen at this QTH. The system completely ignores all types of pulse type noise just as though it wasn't there, as long as they do not saturate the rf-*if* section of the receiver. It would appear this is the best presently known means of invading the never-never land of better than −200 dbm in minimum detectable signal sensitivity. Just trying to calibrate signal and noise generators at these levels is quite a job. On the air testing is slow for at −200 dbm there is no such thing as a dead band—just a morass of birdies and harmonics that are below the thresholds of any other receiver. We have succeeded in getting a firm grip on this tiger's tail—a little taming and we will be cranking 30 to 50 db improvements into communication range equations. A quick look at any of these and it is apparent why the last five years and the next is well worth any possible effort—get in and get your feet wet!

. . . K2TKN

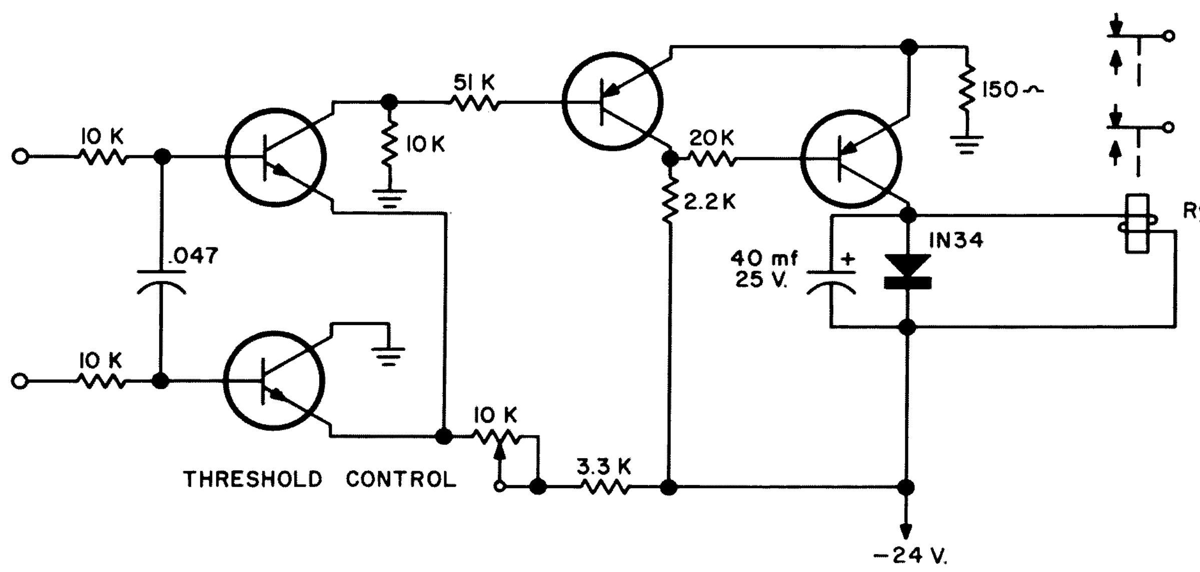


FIGURE 5

Matching the VHF Antenna

Jim Kyle K5JKX

It's pretty well established by now that for anything at all more than low-power local ragchew purposes, feedline loss can't be tolerated at VHF. Granted it's not always possible of practical to use that beautiful low-loss open-wire feedline—but anybody *can* take care to see that the losses in his line are as small as possible.

One cause of increased loss is SWR. Although the additional loss imposed by SWR is usually considered unimportant unless the SWR is extremely high or the line is extremely lossy to begin with, the extra loss is still present and often can add just enough to other loss factors to make the difference between easy copy of a "deep-fringe" station and merely detecting his carrier in there somewhere!

And there's really little excuse for having an SWR greater than 1.001 at your favorite operating frequency. It may increase somewhat as you QSY about a band, but making a proper match between antenna and feedline is so easy that the presence of detectable SWR at the chosen frequency should be cause for shame to any operator.

A couple of years ago, VHF ops had some slight excuse for the situation, because making a perfect match required a bit of ingenuity or special components. But now, there's a gadget available for $4.75 which does it all—and the excuse is gone.

This isn't just a plug for the Cushcraft CL-MS "universal matching stub," however, because getting a *perfect* match with this (or any similar) device requires a bit more thought and knowledge than were written into the factory instructions. And *that's* the purpose of this article.

In case you haven't seen the gadget, it consists of a pair of aluminum rods, ¼ inch in diameter and 42 inches long, spaced 1⅝ inch center-to-center and supported at either end by a polystyrene insulating block which fastens to a modified twin-lead standoff so that the whole thing can be clamped to the antenna mast. Between the insulators at each end are a movable shorting bar which can run up and down the rods, and a pair of movable terminal points (one per tube) which can also be put almost anywhere.

This amounts to a half-wavelength (at 144 Mc) parallel line of 300 ohms surge impedance. According to generally accepted belief, such a line can be used to match any feedline to any antenna, provided the shorting stub and feedline tap point are properly adjusted.

However, it ain't quite that simple. If the antenna's impedance is fairly high or fairly low, the belief is correct. A point exists somewhere along the line at which the resistive component of the complex standing-wave is the same as the surge impedance of your feedline, and when the feedline is moved to that point and the shorting bar adjusted to its proper location to tune out the reactive component of the standing wave then you'll have a perfect match.

But (just to take the hardest case first) what happens when the antenna's impedance just happens to be a pure resistive 300 ohm? The "matching stub" is then perfectly matched *itself* to the antenna, and no matter where along the stub you put the feedline tap the portion of the stub between the feedline tap and the antenna is still a matched 300-ohm line, and as such drops forever out of sight so far as offering any assistance in getting a match is concerned.

To plug in a specific example, let's say we're

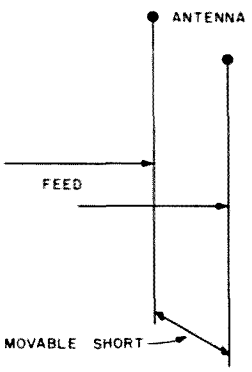


FIGURE 1

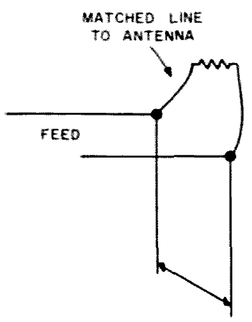


FIGURE 2

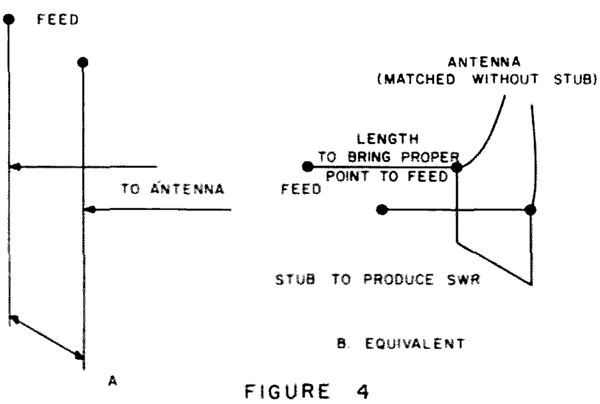


FIGURE 4

using a 52-ohm line (without a balun) to feed an antenna which happens to be exactly 300 ohms, matching the stub impedance. The only place on the line we can find a resistive point at which to feed is ¼ wave above the shorting bar (the resulting ¼-wave shorted stub effectively isn't there) and the best *resistive* SWR we can obtain will be 300/52 or 5.77 to 1. Not good. Toying with the stub length may reduce this a bit by putting in low resistance and fairly low reactance, but we'll find it virtually impossible to get far below 2-to-1 SWR.

At this point, let's pause and look at some pictures. Figure 1 shows the general arrangement and factory-recommended hookup of the "universal" stub. Figure 2 shows what happens in effect when the stub is perfectly matched to the antenna. Figure 3 is a graph showing reactance of a shorted 300-ohm line and of an open 300-ohm line (resistive components depend upon so many variables that no graph can be given for them').

By plugging the values from Figure 3 into Figure 2's effective hookup, you can readily see why the recommended arrangement cannot work whenever the stub is a perfect match to th antenna itself. If a mismatch exists between stub and antenna, then any feedline impedance within the range Zstub/Zant to Zant/Zstub can be matched, but impedances outside this range are also out of luck so far as matching goes.

The real sharp-eyed among our readers will have noticed by now that, from Figure 3, the reactance *anywhere* on a quarter-wave resonant line (a quarter wavelength long, one end shorted and the other end open) is always zero. At a point 1/12 wavelength up from the shorted end, for instance, the reactance looking toward the short will be −519 ohms (distance to short) while that looking toward the open end will be +519 ohms (distance to open) and the sum of the two is zero.

This offers a possibility of turning our gadget into a truly universal matching device; regardless of the antenna or feedline impedances, any one can be made equal to the value of the other plus a parallel *third* resistance, and the resistive component of this resonant line can offer this third resistance.

For instance, a third-resistance value of about 63 ohms would reduce our antenna resistance of 300 ohms down to the 52 ohms necessary to match the feedline. And the quarter-wave resonant line which results when the shorting bar of the matching device is placed exactly a quarter-wave down from the open end of the gadget offers a handy variable RF resistor.

Unfortunately, it doesn't work that way. Q of the line at 2 meters is about 2000, and when all the slide-rule work is done you come up with a tap point less than ¼ inch away from the short. In addition, five times as much power goes into the matching device as into the antenna; it ain't quite worth it.

But don't give up hope. There's another way. It's not quite so easy to see at first glance, but it works and works well. A full description of exactly how it works would require pages of involved math and a few Smith charts

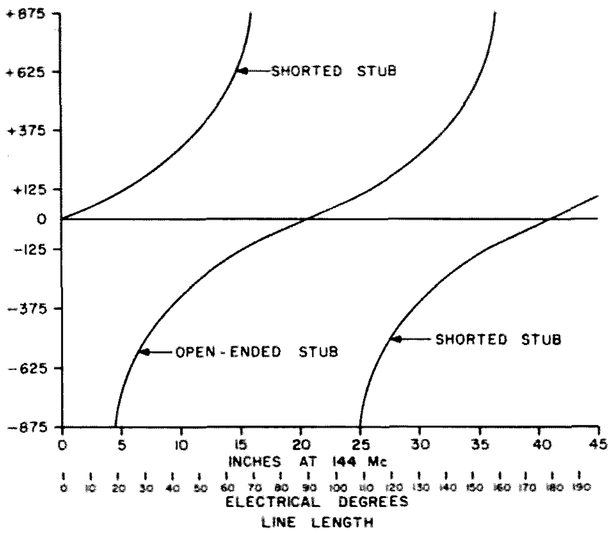


FIGURE 3

as well, but the general picture isn't so hard to see.

Put simply, it's this. If we can introduce a 5.77-to-1 mismatch across a 300-ohm line, there will be a point every half-wavelength along that line at which the effective impedance is 52 ohms of pure resistance. All we have to do is to hook the feedline to the *end* of the matching device as shown in Figure 4 and we're on our way.

The problem of getting the required 5.77-to-1 SWR on a 300-ohm line which is feeding a 300-ohm antenna is a bit more involved; for this, we use the shorting stub, and this is where we have to use a Smith chart for the details (don't let that scare you away—you don't need it in practice). Assuming that we *had* the proper 5.77-to-1 SWR on the 300-ohm line, we would find the line impedance varying from a low of 52 ohms resistive up to a high of 1,731 ohms resistive. In between, the impedance would have both a resistive and a reactive component.

Just for the example, we did use a Smith chart to find out what the reactive component would be at the first point along the line having 300 ohms of resistive component. It's a negative 600 ohms.

Now all we have to do is to supply a positive 600 ohms of pure reactance at the same point to tune out the negative 600, and we have 300 ohms of pure resistance again. Figure 3 tells us that a 14½-inch (at 144 Mc) portion of 300-ohm shorted line will give us the reactance; fortunately, the resistive component of the line is so high that we can consider this to be pure reactance.

The Smith chart also told us how far from the 52-ohm point that 300-j600 ohm point was; the distance is 0.188 wavelengths.

So we connect up as in Figure 4, with the distance from the feedline to the antenna tap measured as 0.188 wavelengths (15-7/16" at 144 Mc) and the distance from antenna tap on down to shorting bar as another 14½ inches, and the job is done. We've achieved a perfect match.

The Smith chart, though, was necessary only to show an example of how this works. In practice it's much easier.

First, try the factory-recommended technique. It works most of the time. But if you can't find a combination of adjustments which gets the SWR down, or if you get a low SWR only with the feedline right up near the antenna connection and the shorting bar anywhere from ⅛ to ⅜ wavelength down from there, then antenna and feedline connections as

shown in Figure 4.

Start with the antenna tap right up at the feedpoint and the shorting bar a quarter-wave farther on. Move the antenna tap for the lowest SWR reading you can get, then adjust the shorting bar to see if you can make it lower yet. When the shorting bar has been readjusted, try moving the antenna tap again. Getting into the right ballpark is easy; reducing the SWR from a 1.1 reading on down to 1.01 can be tedious.

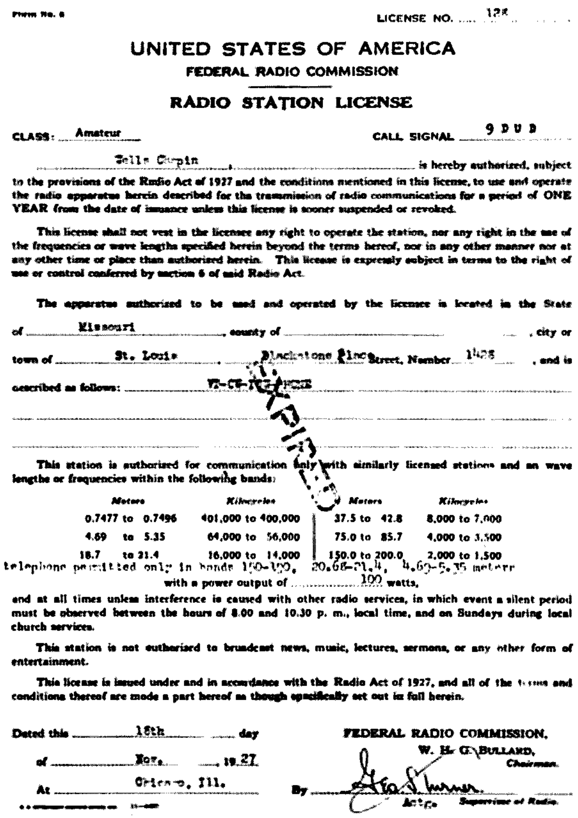
However, don't stop until you can no longer get any flicker of the SWR-meter needle at all. Then you can be sure that you have—for your favorite frequency at least—the perfect match!

. . . K5JKX

Where Have Our Bands Gone?

Wells Chopin W2DUD
118 Woodmancy Lane
Fayetteville, N. Y.

In the beginning around the early 1900's we literally picked a place to transmit on. Things were good—the longer the wave length used the better they thought the results were. You even found a few hams operating around 300 meters. Then suddenly we found ourselves relegated to 150 to 220 meters. This disturbed the gang a little and work was started to get additional space for ham radio. Thus the ham bands were extended with special licenses to wave lengths from 150 meters on down. The famous trans-Atlantic experiments by hams on 100 meters stimulated interest in higher frequencies. The ARRL tests of the higher frequencies followed with the result that it was proved by hams that this new spectrum was indeed quite useful and even gave amazing



Form No. 6 LICENSE NO. 128

UNITED STATES OF AMERICA
FEDERAL RADIO COMMISSION

RADIO STATION LICENSE

CLASS: Amateur CALL SIGNAL 9 D U D

Wells Chopin, is hereby authorized, subject to the provisions of the Radio Act of 1927 and the conditions mentioned in this license, to use and operate the radio apparatus herein described for the transmission of radio communications for a period of ONE YEAR from the date of issuance unless this license is sooner suspended or revoked.

This license shall not vest in the licensee any right to operate the station, nor any right in the use of the frequencies or wave lengths specified herein beyond the terms hereof, nor in any other manner nor at any other time or place than authorized herein. This license is expressly subject in terms to the right of use or control conferred by section 6 of said Radio Act.

The apparatus authorized to be used and operated by the licensee is located in the State of Missouri, county of ......, city or town of St. Louis, Blackstone Place Street, Number 1428, and is described as follows: [illegible]

EXPIRED

This station is authorized for communication only with similarly licensed stations and on wave lengths or frequencies within the following bands:

Meters	Kilocycles	Meters	Kilocycles
0.7477 to 0.7496	401,000 to 400,000	37.5 to 42.8	8,000 to 7,000
4.69 to 5.35	64,000 to 56,000	75.0 to 85.7	4,000 to 3,500
18.7 to 21.4	16,000 to 14,000	150.0 to 200.0	2,000 to 1,500

telephone permitted only in bands 150-170, 20.68-21.4, 4.69-5.35 meters
with a power output of 100 watts,

and at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8.00 and 10.30 p. m., local time, and on Sundays during local church services.

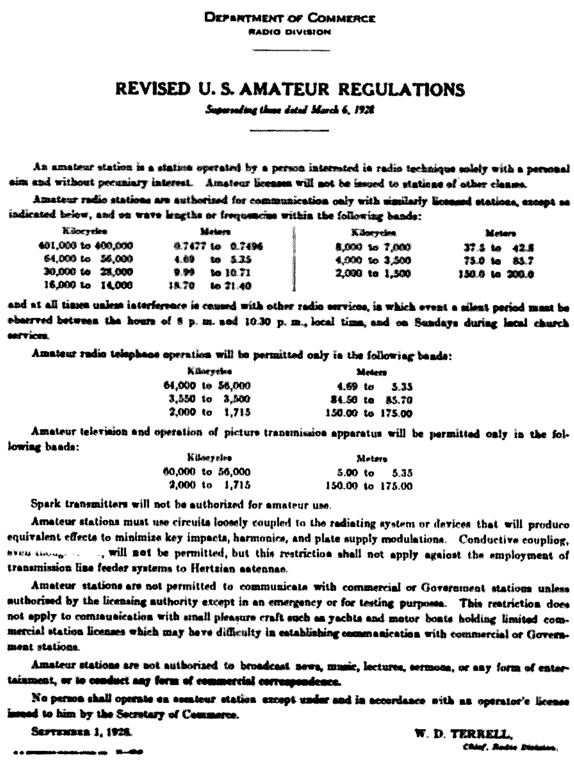
This station is not authorized to broadcast news, music, lectures, sermons, or any other form of entertainment.

This license is issued under and in accordance with the Radio Act of 1927, and all of the terms and conditions thereof are made a part hereof as though specifically set out in full herein.

Dated this 18th day of Nov., 1927.
At Chicago, Ill.

FEDERAL RADIO COMMISSION,
W. H. G. BULLARD,
Chairman.
By [signature]
Actg. Supervisor of Radio.

Fig. 1



DEPARTMENT OF COMMERCE
RADIO DIVISION

REVISED U. S. AMATEUR REGULATIONS

Superseding those dated March 6, 1928

An amateur station is a station operated by a person interested in radio technique solely with a personal aim and without pecuniary interest. Amateur licenses will not be issued to stations of other classes.

Amateur radio stations are authorized for communication only with similarly licensed stations, except as indicated below, and on wave lengths or frequencies within the following bands:

Kilocycles	Meters	Kilocycles	Meters
401,000 to 400,000	0.7477 to 0.7496	8,000 to 7,000	37.5 to 42.8
64,000 to 56,000	4.69 to 5.35	4,000 to 3,500	75.0 to 85.7
30,000 to 28,000	9.99 to 10.71	2,000 to 1,500	150.0 to 200.0
16,000 to 14,000	18.70 to 21.40		

and at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8 p. m. and 10.30 p. m., local time, and on Sundays during local church services.

Amateur radio telephone operation will be permitted only in the following bands:

Kilocycles	Meters
64,000 to 56,000	4.69 to 5.35
3,550 to 3,500	84.50 to 85.70
2,000 to 1,715	150.00 to 175.00

Amateur television and operation of picture transmission apparatus will be permitted only in the following bands:

Kilocycles	Meters
60,000 to 56,000	5.00 to 5.35
2,000 to 1,715	150.00 to 175.00

Spark transmitters will not be authorized for amateur use.

Amateur stations must use circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize key impacts, harmonics, and plate supply modulations. Conductive coupling, [illegible], will not be permitted, but this restriction shall not apply against the employment of transmission line feeder systems to Hertzian antennae.

Amateur stations are not permitted to communicate with commercial or Government stations unless authorized by the licensing authority except in an emergency or for testing purposes. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats holding limited commercial station licenses which may have difficulty in establishing communication with commercial or Government stations.

Amateur stations are not authorized to broadcast news, music, lectures, sermons, or any form of entertainment, or to conduct any form of commercial correspondence.

No person shall operate an amateur station except under and in accordance with an operator's license issued to him by the Secretary of Commerce.

SEPTEMBER 1, 1928.

W. D. TERRELL,
Chief, Radio Division.

Fig. 2

FEDERAL COMMUNICATIONS COMMISSION

RULES GOVERNING AMATEUR RADIO OPERATORS AND STATIONS

EFFECTIVE DECEMBER 1

1938

ALLOCATION OF FREQUENCIES

152.25. **Frequencies for exclusive use of amateur stations.**—The following bands of frequencies are allocated exclusively for use by amateur stations:

1715 to 2000 kilocycles.[a]
3500 to 4000 kilocycles.
7000 to 7300 kilocycles.
14000 to 14400 kilocycles.
28000 to 30000 kilocycles.
56000 to 60000 kilocycles.
112000 to 118000 kilocycles.[b]
224000 to 230000 kilocycles.[b]
400000 to 401000 kilocycles.

152.26. **Use of frequencies above 300000 kilocycles.**—The licensee of an amateur station may, subject to change upon further order, operate amateur stations, with any type of emission authorized for amateur stations, on any frequency above 300000 kilocycles without separate licenses therefor.

152.27. **Frequency bands for telephony.**—The following bands of frequencies are allocated for use by amateur stations using radiotelephony, type A-3 emission:

1800 to 2000 kilocycles.
28500 to 30000 kilocycles.
56000 to 60000 kilocycles.
112000 to 118000 kilocycles.[b]
224000 to 230000 kilocycles.[b]
400000 to 401000 kilocycles.

[a] Subject to change to "1750 to 2050" kilocycles in accordance with the "Inter-American Arrangement Covering Radiocommunication," Havana 1937.

[b] The Commission reserves the right to change or cancel these frequencies without advance notice or hearing.

Fig. 3

results in daylight. This is the period when all our trouble really started. The commercial interests moved in and since that time have been consistently chopping away segments of our bands.

Many individuals have given long hours of their time and at considerable expense in campaigning to save ham radio and our bands. If it had not been for these early hams and the ARRL we would not be here today. Over the years we have consistently lost ground. Why? Let's take a look at some of the official documents of the early period and see where we were and where we stand today. Figure 1 is 1927. It is interesting to note that in 1927 hams in foreign countries were using frequencies in addition to these. For instance: DX was a lot easier—you could work the Australians and New Zealanders across band on 32 to 34 meters. The South Americans were generally between 35 and 36 meters and if you preferred Europe you merely called CQ Europe and looked from 42.8 to 44 meters. This was the DX man's dream—you even knew where to find the country you needed. So the over-all loss of ham bands since 1927 has been substantial. Figure 2 is a page from the FCC regulations of 1928. This is about the time when the ARRL and individual hams finally realized that we were in trouble and fighting for our life. The ARRL and individual hams did an excellent job of promoting ham radio and succeeded in slowing this trend. Analysis of the situation further, you find that since that time, what we have been really doing, is fighting a delaying action. Let's take a look at 1938 in Figure 3. Notice the chopping has begun. Figure 4 shows 1946. Figure 5 is a composite.

It's obvious unless we stop this trend of cutting back our VHF frequencies and moving us toward UHF and EHF, we will, in the near future, be talking on a beam of light and with todays technology maybe that's not such a bad idea.

It would seem, that just like all good negotiators, that for a change we ask for more spectrum than we have and want, so that we have a bargaining position. Perhaps we can reverse this trend or at worst stop this nibbling away

1927 in KC		1938		1946		1963	
1,500	2,000	1,715	2,000	1,750	2,050	1,800	2,000
3,500	4,000	3,500	4,000	3,500	4,000	3,500	4,000
7,000	8,000	7,000	7,300	7,000	7,300	7,000	7,300
14,000	16,000	14,000	14,400	14,000	14,400	14,000	14,350
						21,000	21,450
		28,000	30,000	28,000	29,700	28,000	29,700
56,000	64,000	56,000	60,000	50,000	54,000	50,100	54,000
		112,000	118,000	114,000	148,000	144,000	147,900
		224,000	230,000	235,000	240,000	220,000	225,000
400,000	401,000	400,000	401,000	420,000	450,000	420,000	450,000
				1215 MC	1,295	1215 MC	1,300
				2300 MC	2,450	2300 MC	2,450
						3500 MC	3,700
				5250 MC	5,650	5650 MC	5,925
				10,000 MC	10,500	10,000 MC	10,500 MC
				21,000 MC	22,000	21,000 MC	22,000
						ABOVE	30,000 MC

Fig. 5

FEDERAL COMMUNICATIONS COMMISSION ·

RULES AND REGULATIONS

(TITLE 47 TELECOMMUNICATION CHAPTER I)

PART 12

RULES GOVERNING AMATEUR RADIO SERVICE

EFFECTIVE APRIL 1, 1946

(Revised to May 9, 1946)

(1) *Below 25 mc.*
1750 to 2050 kc.
3500 to 4000 kc.
7000 to 7300 kc.
14,000 to 14,400 kc.

(2) *Above 25 mc.*
28 to 29.7 mc.
50 to 54 mc.
144 to 148 mc.
1215 to 1295 mc.
2300 to 2450 mc.
5250 to 5650 mc.
10,000 to 10,500 mc.
21,000 to 22,000 mc.

(*b*) The band of frequencies 420 to 450 megacycles is allocated for use by amateur stations (and temporarily by other services for special air navigational aids) subject to the limitation of 50 watts peak antenna power.

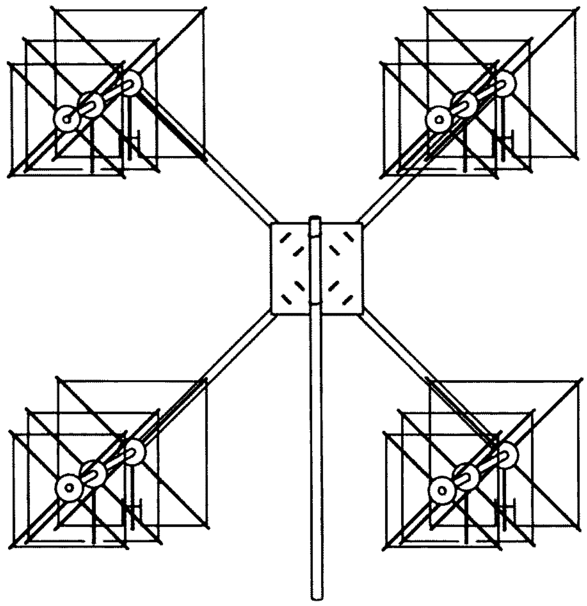
(*c*) The band of frequencies 235 to 240 megacycles is allocated for use by amateur stations until January 1, 1949; the frequency band 220 to 225 megacycles is allocated for use by amateur stations beginning January 1, 1949.

Fig. 4

at our bands. We can prove our ranks have grown and our bands have shrunk and if that isn't argument enough I haven't seen one. Let's pull out the crying towel—history shows us to be the father of radio. Our work proved this VHF spectrum valuable. Chopping away at our bands is like killing your own father—slowly—and that just isn't cricket these days.

This is the time for all of us to pull together. We need more public relations work. Our leadership must be the most intelligent we can get and in addition aggressive beyond anything that has ever been done before.

. . . W2DUD



THE Quad-Quad Array for Two

Doug De Maw W8HHS
10598 Peninsula Drive
Traverse City, Michigan

If I were to count the articles written about cubical quad antennas, I would doubtless need a small computer to get an accurate tally. Yet, this antenna is regarded with continued favoritism due to its simplicity of structure, excellent performance and for the availability of the low priced materials which go into its assembly.

Although numerous articles have been published during recent years which related to multi-element quads, nothing has been presented in connection with broadside stacking of these very excellent antennas. The content of this article is the by-product of 2 years of continual experimentation with 2 meter cubical quad configurations. With the help of W8EEF (who is currently using the array described in the text) the end result of this experimentation brought forth an antenna which has outperformed even the best multi-element Yagis and collinear systems against which it was put into competition. The cost of this entire array is something less than $8.00. The forward gain is measured at 15.5 decibels. The front to back ratio exceeds 28 decibels and the front to side ratio is so outstanding that it was virtually immeasurable.

Although the author regards the use of coaxial cable at VHF with something more than casual disfavor, we shall describe the system with the use of a simple coaxial harness and a terminal impedance suitable for use with RG-11/U cable. (UG!) Should the progressive VHFer desire to take advantage of low loss balanced feedline, he will find it necessary to merely add a conventional half wave balum transformer at the feed point of the array. This will convert the unbalanced 75 ohm terminal impedance to a balanced condition for use with 300 ohm open wire or low loss uhf ribbon line. In addition to the many desirable features adready mentioned in this article, the completed array is exceptionally light in weight and exhibits very little wind resistance. It presents a fairly large aperture (capture area) which is of prime importance in receiving at vhf.

The Structure

The framework which supports the 4 three element quads is made from low priced, thin wall, electrical conduit. 1" dia. material was used in the final model but there should be no reason why smaller diameter conduit could not be used. Aluminum tubing, if readily available, would of course make the array much lighter.

The element supports are made from ⅜" dowel rod (available at the local hardware or lumber store), and are either boiled in paraffin wax or weatherproofed by coating them with exterior spar varnish. This will prevent warping and deterioration caused by weather conditions.

The driven elements, directors and reflectors are made from #10 copper wire which is passed through holes drilled in the outer ends of the wooden dowel rods. The tuning stubs on the reflectors are continuation of the #10

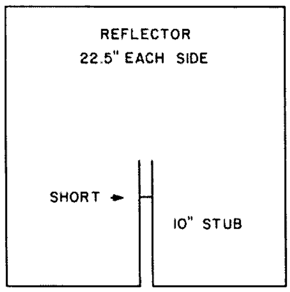
wire used for the reflectors.

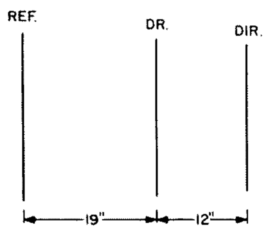
The metal plate located at the center of the framework, which attaches to the antenna mast with U-bolts, is made from ¼" steel plate.

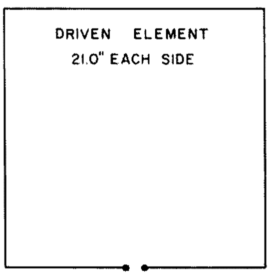
The wooden supporting dowels for each element of the array are glued into wooden center hubs (cut from ¾" plywood with a circle cutter) which are held in place on the ¾" conduit arms with 2 set screws as shown in the illustration. Other methods for fabrication of the supporting assemblies should present themselves after examination of the illustration in the article. However, not being particularly skilled at metal work and with materials being scarce in this area, the method shown was used.

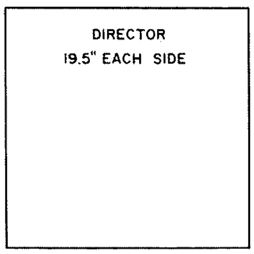
Harnessing

The individual bays are adjusted with the spacing between elements to give a terminal impedance of 75 ohms at 145 mc. The 4 bays

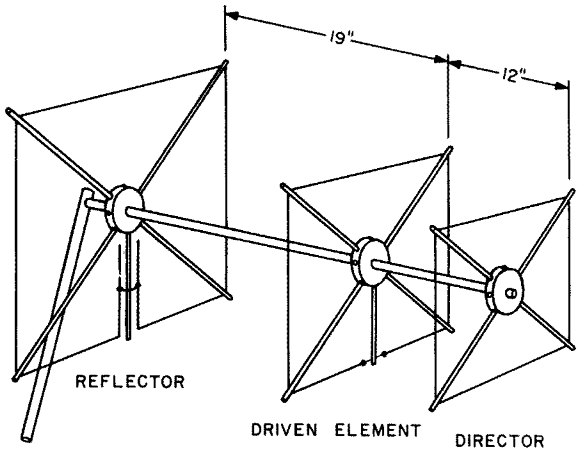


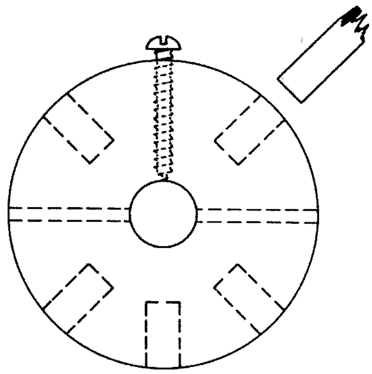






Element data
SWR is 1:1 to 1 over 1 mc
144.5 to 145.5 with these dimensions and spacings.





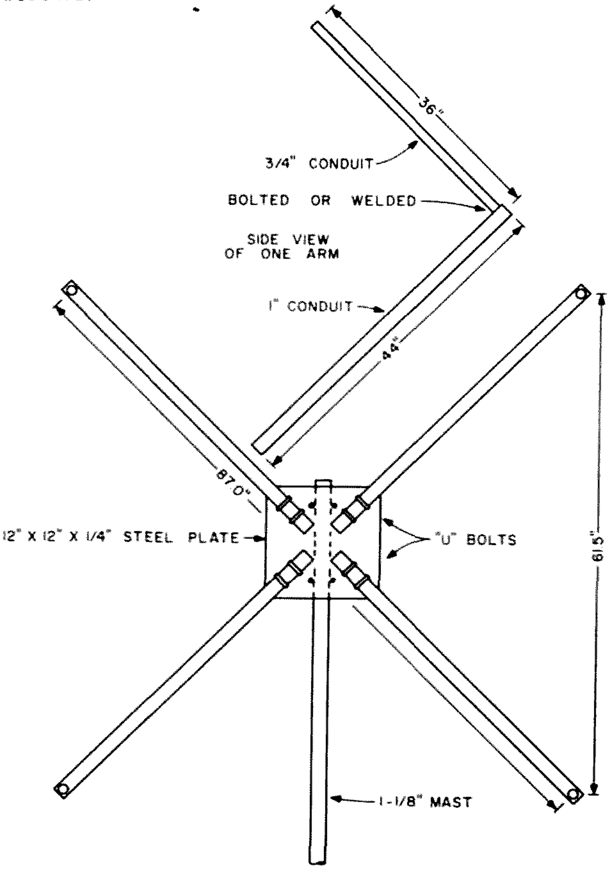
Hub detail
Material
¾" clear pine or plywood
⅜" dowel rod
set screws #6 x 1 ½"
sheet metal screws

are spaced ½ wavelength apart, both vertically and horizontally. Added aperture and possibly slight additional gain could be realized by using full-wave spacing between bays. We did not exploit this possibility because of the added size of the array.

It is necessary to use 3 quarter wave matching transformers made from 50 ohm coaxial cable during the harness assembly. These pieces are spliced into the 75 ohm sections of line, taped with scotch electrical tape at the points of connection and then coated with epoxy resin cement to prevent moisture from entering the coax cables. RG-59/U and RG-58/U line was used in the described model. Better results would be obtained through the use of RG-11/U and RG-8/U cables. The latter of course are somewhat more bulky. All connections in the harness should be well soldered to prevent intermittent conditions and possible corrosion at some later date.

The harness cables can be held securely in place by either taping them to the supporting

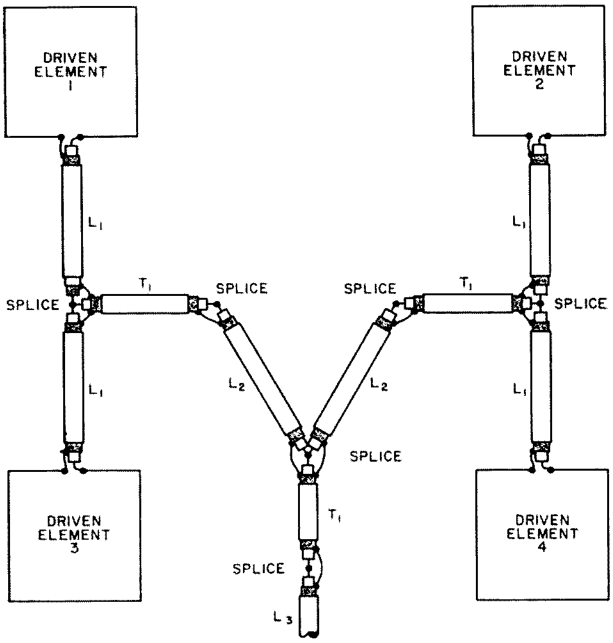
framework or using cable clamps attached to the steel supporting frame with sheet metal screws.



Tune-up After Assembly

Assemble all bays in their respective positions on the supporting framework. Next, attach a suitable length of 75 ohm coax cable temporarily to the feed point of one of the upper bays. Do not attach harness until later! Support the entire antenna structure in such a manner that the bottom 2 bays are at least a wavelength or more above ground and well away from nearby objects. A field strength meter of some type should next be placed 5 or more wavelengths directly in front of the array and preferably 2 or 3 wavelengths above ground. Use a horizontal pick-up antenna on your fs meter. Next, apply transmitter power to the feedline you have attached to the upper bay. While observing the reading on your fs meter (a buddy is handy for this), carefully adjust the shorting strap on the reflector tuning stub for maximum forward power as noted on the meter. Once this point has been located, solder the shorting strap in place.

Antenna support construction
Material:
4 pieces 1" conduit 44" long
4 pieces ¾" conduit 36" long
8 U-bolts for 1" conduit
2 U-bolts for 1 ⅛" mast
1 12" x 12" x ¼" steel plate



QUAD-QUAD ANTENNA HARNESSING ARRANGEMENT

L—1 RG-11/U, any length (short as possible) but all L-1's must be same length.
L—2 RG-11/U, any length but both must be the same.
T—1 RG-8/U, 12¾" long.
L—3 RG-11/U, any length to transmitter (or through balun to 300 ohm line).

It would be wise to adjust each individual bay in the same manner as we have just described. However, if you do not wish to be this thorough, good results can be secured by carefully measuring the length of the tuning stub from the shorting strap to the reflector, and duplicating this dimension on the other 3 bays. Next, comes the harness installation. Details for this can be found in the illustration showing the harness assembly. A word of caution—make certain that the same polarity is observed on each driven element of each bay, when attaching the harness. In other words, make certain that all coax center conductors attach to the right hand terminal of the driven element and all outer shields attach to the left hand terminals. If you should mistakenly cross phase these bays, serious impairment of the array's performanace would result due to improper phase relationships.

Performance

There are several distinct advantages to be gained through the use of this antenna type. First, the quad-quad array exhibits a diversity effect with regard to polarization. It responds equally well to vertical and horizontal signals. I know there will be some who will disagree with this statement, but observations over the two year period have proven this to be fact. In addition to the polarity convenience, fading on tropo work is far less than with other horizontally polarized arrays. This of course can be attributed to the dual polarity characteristics of the quad array, all of which is advantageous under adverse conditions. Another feature of this antenna system is its excellent back and side rejection. This is especially helpful in congested metropolitan areas where several stations are operating close in frequency and creating cross talk problems etc. Minor lobes are virtually non-existent. This helps in rapid pinpointing of distant signals. The antenna presents a large capture area which is particularly beneficial in receiving. (The larger the capture area, the greater the slice you take from the air and consequently the more signal you will collect on your antenna.)

The first model of this antenna was built and used by the author. It was built on a wooden framework. There were 4 bays but each was comprised of a 2 element quad. The elements were made of heavy duty aluminum clothesline wire and all connections to them were made by using sal-met soldering flux. The system was in use for one year, mounted 40 feet above ground and surrounded by nearby trees. With 25 watts of transmitter power, nightly skeds were maintained for several weeks (CW) with W8YIO who was 190 airline miles distant. Many phone and CW contacts up to 600 miles away were made with this same set-up. Though the less elaborate quad-quad array had a reduced forward gain compared to the one described in this article (12.3 db), it did a remarkable job and was taken out of service only because further experimentation was desired.

By stacking 2 of these arrays, one above the other, a very effective DX antenna could result.

Without the hard work and cooperation of W8EEF, who helped develop this antenna system, this article would not be possible. We hope you will be as pleased with your quads as we are with ours.

. . . W8IHS

Introducing a new type of audio circuit for Transistors

The Class D Amplifier

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Oklahoma City 11, Okla.

Long-time readers of these pages will recall that from time to time we have latched onto the latest circuit developments from other countries, working on the theory that a good idea knows no national boundaries.

Well, they've done it again. Our British cousins have developed a new type of audio circuit, specifically for use with transistors, which allows efficiency comparable to that you'd expect to find in a Class C rf stage!

Since it *is* so different from the conventional three classes of amplifiers, they've dubbed it "Class D" operation. Unlike the conventional three classes of amplifiers, Class D depends on *power* relationships rather than voltages.

Before we get into the details of just what it is and how it works, let's look at the "black box" operating characteristics of Class D amplifier. Like a conventional Class A, it draws the same total current from the supply throughout the audio cycle. However, like a Class C, the active devices inside (the output transistors, in other words) dissipate only a small percentage of the power drawn from the supply. Something like 99 percent of the power shows up at the output terminals! Input drive requirements can be as little as you like.

How all this comes is a bit complicated, though. Let's start by abandoning the concept of a transistor as being a gadget "just like a tube only a little bit different" and look at it as another type of animal—a current-controlled switch!

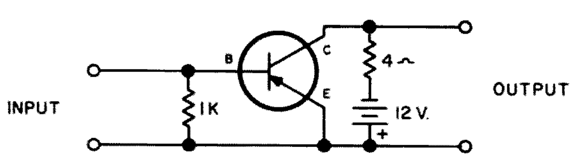

FIGURE 1

If we hook up a transistor according to the schematic in Fig. 1 and leave the input terminal floating, we will find almost the full supply voltage present at the output terminal. With no base current being supplied, the transistor is a pretty good approximation to an open circuit.

But if we now shove, say, one milliamp of current into the base (a flashlight cell in series with a 1500-ohm resistor is a one-mil current supply) we will find almost no voltage at all present at the output. The transistor is now biased to full conduction, and its resistance between collector and emitter is a small fraction of one ohm.

You can see that we are completely ignoring the usually used "linear" portion of the transistor's characteristics, and operating either at cut-off or at saturation.

Now let's look at what's happening inside the transistor so far as power consumption is concerned, when we operate in this way. The (purely hypothetical) pure curve of Fig. 2 will help to examine this.

With no base current and the "switch" open," the collector-to-emitter voltage is virtually equal to the supply voltage. This is point 0 on Fig. 2. You can see that almost no current flows through the transistor, so the internal power dissipation (being equal to C-E voltage times C-E current) is vanishingly small.

With full base current the "switch" is "closed" and current flow is limited only by the series load resistor. We have assumed for the purpose of Fig. 2 that this value is 4 ohms in our example. With a 12-volt supply, 4 ohms

will allow 3 amperes to flow. The voltage from collector to emitter is almost zero; the transistor operates at point C. Again, however, the internal power dissipation is vanishingly small.

During the brief instants when the switch is turning on or off, the transistor operating point will shift from 0 to C along the dotted line, which is a load line for a 4 ohm resistor. The solid curved line represents a power dissipation of 1 watt; you can see that, while internal power dissipation is almost zero at each end of the load line, it becomes quite high during the transition periods between "on" and "off." However, since the transistor makes the trip from 0 to C or vice versa in a matter of only a very few microseconds, this does no damage.

Fig. 2 has one more point for us—when the switch is *closed* we are dissipating power, but this power is used in the load resistor rather than in the transistor itself.

Now assume that we send a regular series of pulses, a perfect square wave to current, to the input terminal of our switch. We could expect to get a regular square wave out. If we placed a DC ammeter in the supply lead, we would read *not* 3 amps but instead 1½ amps of current—actually, half the time 3 amps would be flowing and the other half of the time the current would be zero. The voltage, likewise, drops to half. The load resistor would be dissipating 1½ times 6, or 9 watts; the transistor would, as always, just be loafing along powerwise.

All of which, you may say, is very fine but what does it have to do with an audio amplifier, Class D or otherwise? Actually, this concept of the transistor as a switch is the heart of the Class D circuit. As shown in the previous paragraph, the transistor just loafs along even though the load is consuming 9 watts of power. What we are talking about is 99 percent efficiency; all we must do now is find a way to use this trick in an audio amplifier.

To see how this is done, let's back away

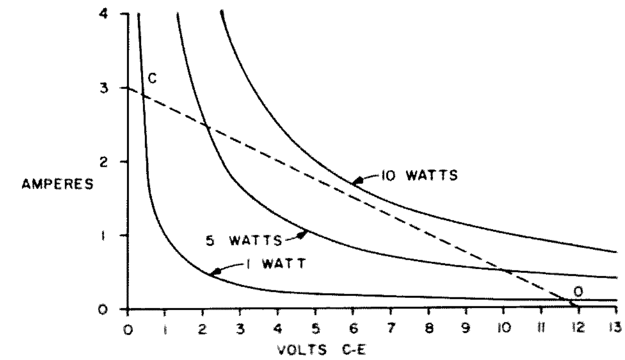

FIGURE 2
Switch curve.

for a moment and consider the vacuum-tube Class B amplifier. This gadget, also, is a switching amplifier—though few of us consider it in that light. Still, only one of the two tubes works at a time. For half the cycle one tube operates and the other rests, then on the other half-cycle their roles are reversed.

This comparison provided the clue but not the complete answer. After all, the vacuum tube Class B amplifier is working as a linear amplifier when it's working. Our transistor switch is either *on* or *off*, with no in-between.

It's almost impossible to give proper credit to the inventor, since so many people in Britain are working with this basic type of circuit. But someone with a flash of genuis happened to look at the theory of pulse modulation while realizing that audio is *power* rather than either current or voltage alone. From there it was a simple step to the idea of pulsing our transistor switch at a supersonic rate, and varying the width of each pulse in direct proportion to the audio power present at the amplifier input.

This produces, at the output of our switch, a string of supersonic pulses whose width (and resulting individual power content) is determined by the input signal. To go back to our example in Fig. 2, let's assume that our square wave of current has a frequency of 50 kc. This makes the switch be *on* for 10 microseconds and then *off* for the next 10 microseconds. The total length of time for one cycle of the square wave (on time plus off time) is 20 microseconds. The equal *on* and *off* times result in 9 watts being dissipated in the load resistor.

Now if we can vary the makeup of the square wave to make the *on* time longer and the *off* time shorter, with their total still 20 microseconds, we can change the amount of power dissipated in the load. For instance, if we lengthen the *on* time to 15 microseconds and cut the *off* time back to 5, the load will be dissipating 3 amps for ¾ of the time and nothing for the rest of the time. Average current flow becomes 2¼ amps, instead of 1½, while the voltage drop (average) rises to 9 volts from the previous 6. The power dissipation has thus climbed from 9 watts (1½ times 6) to 20¼ watts (2¼ times 9).

If we widen the *on* time to 19 microseconds and thus cut the *off* time to only 1 microsecond, the average current in the load will be 19/20 times 3 amps, or 2.85 amps. At the same time, the average voltage drop across the load will be 19/20 times 12 volts, or 11.4 volts. The average power in the load under these conditions is 2.85 times 11.4, or 22.49 watts.

Similarly, we can reduce the *on* time and lengthen the *off* time to reduce the average power in the load. By now you probably have the picture, so we'll only run this calculation for the extreme 1-microsecond-on, 19-microseconds off, case. Under this condition, average current in the load is 1/20 of 3, or .15 amp, while voltage is 1/20 of 12, or .6 volt. Resulting average power is 0.09 watt. Thus we can start with a perfectly square wave and produce 9 watts in the load, and by varying the proportions of *on* and *off* time in the wave have anything from 0.09 watt to 22.49 watts in the load circuit.

As we mentioned earlier, this square wave (we should say pulse wave, since it is square *only* at one operating point) is at a supersonic frequency, so we can't hear it. But if we vary the width of individual cycles at an audio rate, the power in the load will also vary at an audio rate—and this variation in power will come through to our ears loud and clear. Our ears act as low-pass filters cutting off somewhere above 10 kc, and the pulse wave itself makes no difference.

However, if you keep dogs (who *can* hear the 50 kc signal) or if you intend to use a Class D circuit as a modulator (we'll get into this a little later) it would be a good idea to put an additional low-pass filter at the output of the amplifier, just to make sure the pulse wave doesn't get out and cause trouble.

At this point, we have a working Class D circuit—except that we blithely said before that we varied the pulse width at an audio rate, and didn't mention *how* we do this. Anything that will give us pulse-width modulation will work, but in the interests of keeping things as simple as possible let's look at one specific hookup which is ideal for transistor use.

First, of course, we must generate our 50 kc square wave. Instead of making it square to start with, let's make it a sawtooth. Then let's feed it into a Schmitt trigger hookup set to fire at half the sawtooth peak voltage, to square it off.

The reason for doing it this way instead of making it square to start with is that we can now feed our audio wave into the Schmitt trigger at the same time and automatically vary the firing point to vary the proportions of the pulse wave. Fig. 3 shows how this works.

To start with, let's examine it with just the sawtooth present. Things always have more meaning with numbers, so let's assume that our sawtooth is 10 volts high at its peak, and the Schmitt is set to fire at 5 volts. Since we're using a 50 kc sawtooth, it will take 20 microseconds to climb from 0 volts to 10 volts, and

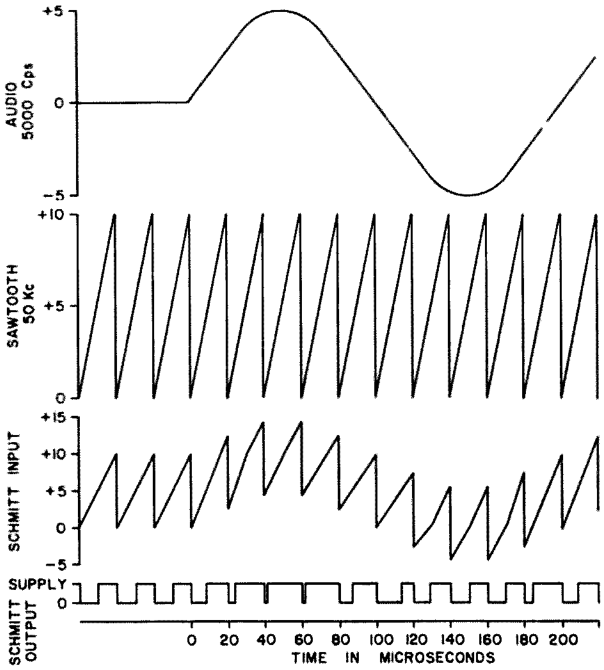

FIGURE 3

Varying the pulse wave.

then it drops back to 0 volts. In the figure, the vertical scales are all in voltage while the horizontal scale is in time.

As the sawtooth starts from 0, the Schmitt sits at 0 input and its output is similarly 0. (The Schmitt, in case you didn't recognize it, is nothing but a pair of switches hooked up so that each one turns the other one off.) After 10 microseconds, the sawtooth voltage has risen to 5 and the Schmitt turns on, bringing its output voltage up to the supply-voltage level. As time passes, the sawtooth keeps rising but since the Schmitt is already turned on it makes no difference. At 20 microseconds, the sawtooth falls to zero and as it passes through 5 volts on the way down, the Schmitt turns off and its output drops to zero also. From here, the cycle repeats. You can see that the Schmitt is *on* for 10 microseconds and then *off* for the next 10, and so forth.

Now let's see what happens when we add a 5 kc sine wave to the input. Just to make it simple, let's make this wave the same peak-to-peak voltage as our sawtooth, or 10 volts.

Starting as the sine wave crosses the zero point, the input to the Schmitt will also be zero since the sum of the sine and sawtooth waves is zero. The sine wave is rising toward its 5 volt positive peak at the rate of 0.14695 volts per microsecond at this point (the first 10

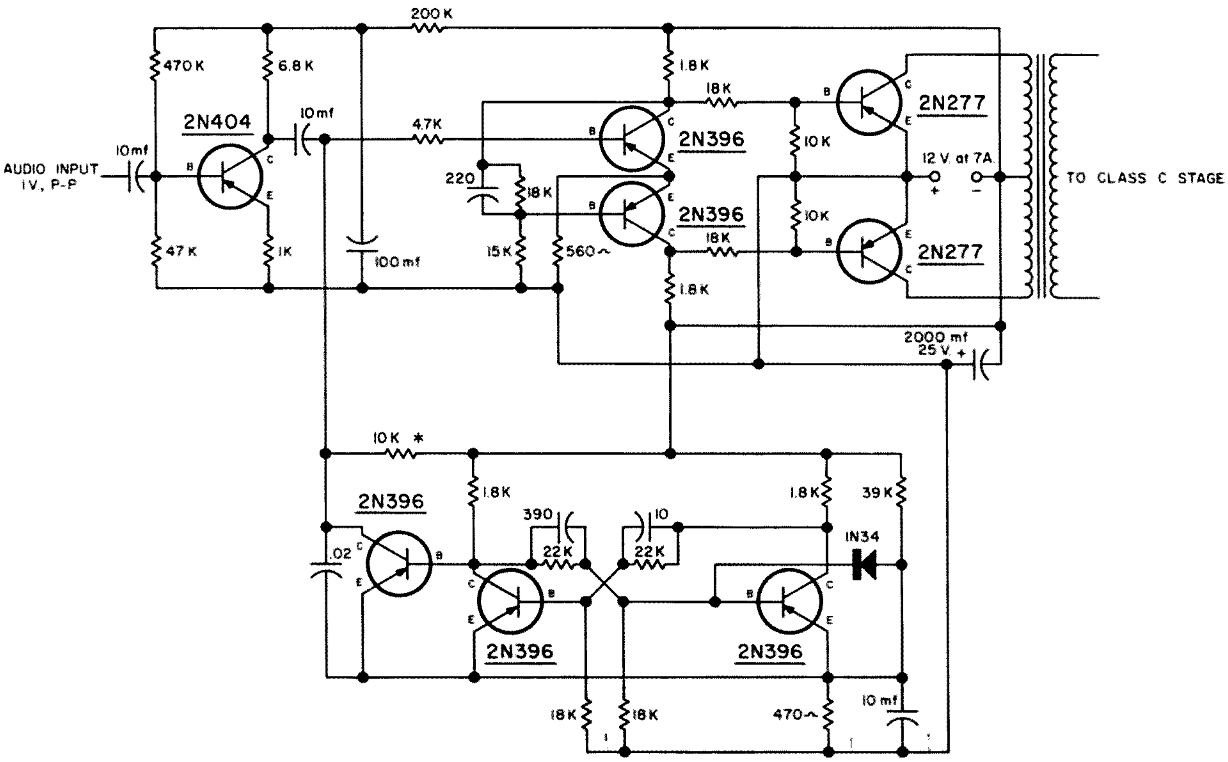

FIGURE 4

Experimental 70 watt class D modulator. Modulator transformer: primary to handle 3 amps, 4 ohms dc resistance (each half)—secondary to suit. Either side of supply may be grounded. Adjust value of 10 K resistor for square wave at bases of 2N277's with no audio. Adjust 390 mmfd capacitor if necessary for 50 kc square wave frequency.

microseconds represent 18 degrees, and the voltage at the end of this time would be 5 times sin 18, so the rate in volts per microsecond is 1/10 of this or 0.14695) while the sawtooth is climbing at ½ volt per microsecond. At any given time the Schmitt input voltage is the sum of these two, so that we can add the two rates together and divide into 5 to find out when the combined wave will reach 5 volts and turn the Schmitt on. The more-or-less exact time when this happens is 7.72859 microseconds after the zero point.

From this 7¾ (approximately) microsecond point the Schmitt remains on until turned off when the sawtooth falls back to zero at 20 microseconds. For this cycle of pulse wave, the *off* time was 7¾ mircoseconds while the *on* time was 12¼ microseconds.

Starting point for the next cycle finds the sine wave at 2.389 volts (it is 36 degrees from zero, so the voltage is 5 times sin 36) while the sawtooth is at zero. Going through the same procedure of determining the rise rates, we find that the sum of the two waves will pass through the 5 volt point 4.03586 microseconds later and turn the Schmitt *on*, where it will remain until the sawtooth next falls to zero.

So during this second cycle of pulse wave, the *off* time fell to 4 1/32 microseconds while the *on* time rose to 15 31/32 microseconds.

We won't go all the way through the cycle this way since the figures get extremely complicated near the peaks of the sine wave and you undoubtedly see how it works by this point. On the negative going half-cycles of audio it works the same way except that, since the sign of the audio voltage is reversed, the difference between the two waveforms rather than their sums determines when the Schmitt fires. Thus the *off* time will increase while the *on* time decreases.

At this point someone is sure to ask "Why not use the Schmitt itself as the output stage? It's a switch, you said." And the answer is that it can be used if you want to keep things as simple as possible.

However, the real beauty of this type of amplification over all the more-conventional classes is that, once you have converted the audio to a modulated pulse train, you can boost it on up to any level you want with a series of switches! A typical Schmitt, designed for fastest possible switching (we have to keep that transition time short, remember, to stay out of the high-power-dissipation regions with our power transistors) will switch maybe 5 watts on and off. It can *control* a switch which is handling 500 watts! This one, in turn, can

control a 50 kilowatt switch. And so forth. For an extremely low-power amplifier, Class D is hardly worth the trouble of putting together the pulse modulator. But for moderate or high power, it drastically simplifies the circuitry.

Now that we've gone through the Class D amplifier to see how it works, you'll probably want some practical how-to-build-it information. As this is written there has been no opportunity to build and de-bug a circuit, but the design of Fig. 4 is offered as a starting point for any interested experimenter.

The eagle-eyed among you will note several differences between Fig. 4 and the example circuits mentioned earlier. The most obvious, and the most major, is that it uses push-pull switches driven from the two halves of the Schmitt, instead of a single switch.

Using switches in push-pull as shown here doesn't have all the advantages associated with tubes in push-pull, but does have one great advantage—current through the total transformer primary will always be the same. When one switch is on, the other is off, so current in one side will be maximum when the other side is minimum. But averaged over an audio cycle, the average current in both sides is equal; it also happens to be equal to the no-signal current, giving the circuit its similarity to a Class A circuit in this respect.

No low-pass filter is shown, although the circuit is intended as a modulator. This is due to the transformer used, a common 115 volt filament job. A transformer of this type is a pretty good low-pass filter in itself, at 50 kc. Should any 50 kc energy get out and give you spurious sidebands at 50 kc intervals from your carrier frequency, add an rf choke between modulator and final, with a capacitor to ground large enough to bypass the 50 kc without hurting your 3 kc audio limit.

Audio input level isn't especially critical, but it should not be allowed to exceed the peak level of the sawtooth (which in this circuit is about 10 volts). If it does, you'll get a clipping effect since the sawtooth voltage is used to turn the switches *off* every cycle!

For additional data on this type of circuit, try the writings of D. R. Birt and K. C. Johnson in *Wireless World*. In addition, an article by George F. Cooper in the June 1963 issue of *Audio* (published by Radio Magazines, Inc., Mineola, N. Y.) discusses the circuit as it applies to high-fidelity amplifier design. For other approaches to trigger circuits and transistor switch design, try the *G-E Transistor Manual* and Howard W. Sams' *Transistor Circuit Manual* by Allan Lytel. But for the best information on the subject, try it yourself!

. . . K5JKX

12 volts from 6

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Dynamotors in a mobile operation are things of the past. With their 30% efficiency, commutator arcing and mechanical inertia, they cannot compete with transistorized power supplies.

However only a 30-40 watt rig can be operated from a 6 volt battery. It is possible to build a higher power transistorized supply, but buying a 12 volt car is cheaper.

The following two circuits designed to provide 12 volts from a 6 volt car system were built and tested. Both require no changes in your present electrical system other than inserting one resistor.

In the first one (Fig. 1) the value of resistor R1 is chosen so that a voltage drop across it is 6 volts with charging current to the battery held constant and reduced about 50%. This will make available 12 volts at the "A" terminal of the generator. A typical case with a 30 amp generator will look like this: the generator is producing its normal 30 amps, but the voltage at "A" is now 12 volts instead of normal 8 because the field coil has 12v/3 amps across it instead of usual 8v/2 amps. The 12 volt output is split in two equal parts—15 amp is available for your 12 volt load (180 watts), and the other 15 amps are dropped by R1 to 6 volts and are used to charge the battery. Your voltage regulator MAX current contacts are adjusted to open at 15 amps instead of 30, and their action will keep the generator output constant at various engine speeds.

It is recognized that this method puts 50% overload on the generator, but if your engine does not overheat and you do not drive through

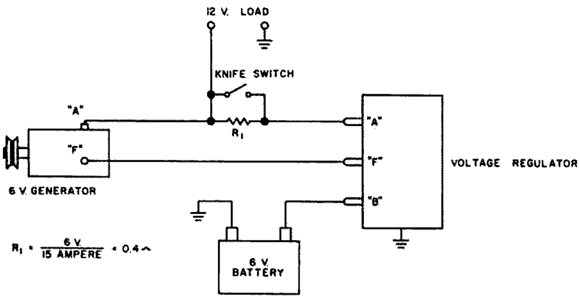

FIGURE 1

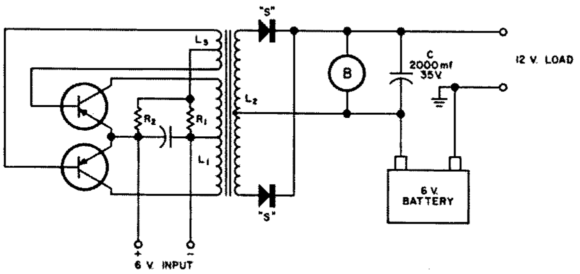

FIGURE 2

See TRIAD brochure TY-61 for components not shown here.

the desert, it seems to be perfectly safe. When 12 volts are not needed, switch SW is closed and the system returns to normal, except that the maximum charging current is now 15 amps (10 ohms across "F" and GND on your regulator will restore it to 30 if necessary).

A word of caution—open R1 will result in a burned out generator, better use a 150-200 watt resistor.

Second circuit (Fig. 2) makes use of an ordinary transistorized dc to dc converter. Both input and output are 6 volts, the output is simply connected in series with the car battery providing 12 volt output for the load.

No transformers are available commercially but they can be easily wound at home. No calculations are necessary—you just pick up any 100 watt 60 cycle transformer that has a 6 volt winding on it and remove all wire, counting the number of turns on the six volt winding only. Using the heaviest wire possible, wind two identical centertapped windings using the same number of turns *each side of centertap* as the original 6 volt winding had. These windings will be I1 and L2. L3 is same as L2/L3, but uses thin wire about 28 to 30 gauge.

"B" is a 12 volt light bulb. It serves as a bleeder passing about one ampere and doubles as an indicating light showing the presence of an output.

The 6 volt, 12 amp output (72 watts) in series with your car battery will provide 140 watts of 12 volts output to the load. "S" are silicon stud rectifiers rated 50 PIV at 15 or more amps. Do not use selenium units as the voltage drop across them is too high. Transistors are the same as you would use for a regular 6 volt transistorized power supply delivering the same wattage output. Triad brochure TY-61 will help you select them as well as other component values for your circuit.

The same ideas can be used to get 24 volts out of a 12 volt car electrical plant.

. . . K6BIJ

A Single Tube Oscillator-Multiplier

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Need something small yet reliable to provide a crystal-controlled signal at 200 mc or below?

Here's a single-tube circuit which can do the trick, yet is equally useful at 1800 kc if your interests run to low-band work. And the single-tube description doesn't resort to tricks like the Compactrons to do it, either. We're talking about just one little pentode. If you use a triode-pentode or the like, you can move the upper frequency limit out to 600 mc at least!

The schematic may look a bit odd at first, but here's what we have: Forgetting the suppressor and plate and considering only the cathode, grid, and screen, we find a conventional Miller crystal oscillator. This circuit works with either fundamental or overtone rocks, and will give good output as high as 50 mc or more with third-overtone crystals.

Now let's move on to the plate. By using

electron coupling, we have separated the crystal and plate circuits sufficiently that the plate tank may run straight through, double, triple, or even quadruple. And by using a 50 mc overtone rock to start, then quadrupling in the plate circuit, we come out at 200 mc from the single tube.

For some examples of the circuit's usefulness, a 6U8's pentode half can be used with a 45.667 mc crystal to get 137-mc output from the tripling plate circuit; this will be adequate to run a 144 mc to 7 mc converter, leaving the triode half of the tube free to use as a mixer.

Again, a 6AG7 or 6CL6 can provide 48 mc or 50 mc output, from 24 or 25 mc overtone rocks and doubling in the plate. With this circuit a 2-tube 90-watt 6-meter CW rig could easily be built.

At lower frequencies, a 2-band CW rig could be designed around 7 mc rocks, a multiband tuner in the plate, and a pi-net output. Very little more would be needed to make it operate on 40, 20, and 15, and 10-meter use would not be impossible. Suitable tubes would be a 6CL6 and a 6DQ5, and input could run up to 120 watts or more. How about this for portable operation?

Some of the less-obvious advantages offered include easy crystal switching, since one side of the rock is grounded, and almost perfect isolation of the load at all frequencies so long as screen voltage is kept low enough so that the plate doesn't swing below the screen.

Let's be fair; this circuit didn't originate here. It came from Ed Steinberg, and was originally published in Electronic Design magazine. However, Electronic Design is an engineering-level publication with circulation restricted to professional engineers, and this circuit is just too good not to pass on. Have fun with it!

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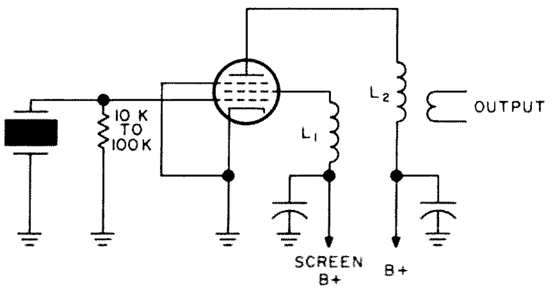

L_1 resonates at xtal freq.
L_2 resonates at desired harmonic
SCR B+ should be regulated

More About SSB, DSB, AM, etc.

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The battle started in the early 50's when hamdom divided against itself over "SSSC" (which was too much of a tongue twister to survive). John Costas made matters worse in 1956 when he added DSB as ground for further subdivision. I've followed this thing through the pages of I.R.E. (including the Professional Group on Communications Systems), Electronics, CQ, QST, 73, and heard it discussed in every other gathering of hams for about 10 years. It has grown out of all proportion and left men without the use of their reason—much like racial prejudice. I am finally compelled to have my say. Congratulations, W3AQT: you finally got to me (April issue, p 17).

The Ground Rules

There are generally two basic types of people who argue modulation systems. They are: those who understand and enjoy the mathematics of communications systems and those who understand a faint voice running 2 watts 3000 miles away but wouldn't know a Bessel function if they tripped over it. Most hams fall somewhere in between.

Since each group uses different approaches, they have divided the whole mess into two distinct battles, each with two sides. Most of the present confusion comes from trying to settle the matter once and for all in so general a way that it answers the problems of both groups. It cannot be done.

Since this is being written for ham consumption, we can leave out the jazz that goes into a systems study for NASA or the Signal Corps and consider only the particular problems that a ham might have. In articles written for the engineering profession, such things as input power, weight, cost, or reliability might be suitable criteria. Of these, cost is perhaps the only one which would also apply here, and more will be said later on this point although no numerical comparisons will be attempted. So from here on, this discussion will be concerned with *voice* (not sine wave) transmission, using a transmitter whose average power input to the final amplifier stage is limited to 1 kw. Just to keep things simple, it will be assumed that only the final amplifier contributes power to the antenna although more about this point later on. We will consider the fact that since a ham does not have control over both ends of the transmission circuit, he must determine the results of operation between his transmitter and the various types of receivers with which he may come in contact. (If you ever tried to operate wide band FM in the old days, you know what I mean.)

Finally, a word of warning—if you read the high brow magazines, make sure that arguments presented there are based on the same sort of comparisons that are important to you.

Power

One of the first things that must be considered is just what contributes to the ability of a communications system to transmit intelligence. At the receiver, the important thing is the signal-to-noise ratio, that is, the amount by which the signal exceeds the noise. Nowadays, nearly everyone is familiar with the concept of signal-to-noise ratio when used at the receiver but this involves a knowledge of the propagation losses, antenna gains (or losses), etc. If we used the concept of signal-to-noise ratio as it exists *at the transmitter*, we have in effect the same concept without the propagation and antenna considerations. Granted, the actual number of signal-to-noise ratio at this point might seem astronomically large, but if we further refine the concept by eliminating the temperature and Mr. Boltzmann's constant, we come to the concept of *intelligence power per cycle* of bandwidth. This is the real way to compare modulation techniques.

Many discussions on this subject bog down over a peak vs. average power argument. You

have all heard the "2 kw peak envelope power" bit for SSB. Have you ever seen an AM envelope on a scope? Have you noticed that with 100% modulation the peak voltage is twice the unmodulated voltage? Since power is proportional to the square of the voltage, then it would seem that the peak envelope power for AM is 4 kw. Of this, 2 kw is in the peak carrier and 1 kw is in each peak sideband. So what! People don't talk in peaks but in a whole series of sounds having varying degrees of loudness. By clipping we can suppress the peaks and have a high average level. This is what must compete with the average noise power at the receiver.

Here's a New One for You

If you are still skeptical, let me simplify by giving an example. Consider a pulse code modulation system in which speech, having a spectrum lying between 300 and 3,000 cps, is sampled at a rate of 2 samples per cycle or more. The sampling rate must then be 6 kc/s or higher; let's stop at 6. Since we want to exceed the noise at the receiver with these pulses we will keep them at their maximum value at all times. Therefore, we will avoid pulse amplitude modulation (PAM) and use either pulse width modulation (PWM) or pulse position modulation (PPM). See Fig. 1 for a diagrammatic explanation of these modulation systems.

If we use PPM, all of the pulses are alike. If we use PWM the width will be varied above and below an average value. Since the modulation frequency does not go down to dc, we can assume the average value in our power calculations. Let's start the fun by assuming a 1 microsecond pulse width. With 1 microsecond pulses transmitted at a 6 kc/s rate, we have a duty cycle of only 0.6%. This means, that for an average power of 1 kw, we can use a peak power of 167 kw. . .!!!

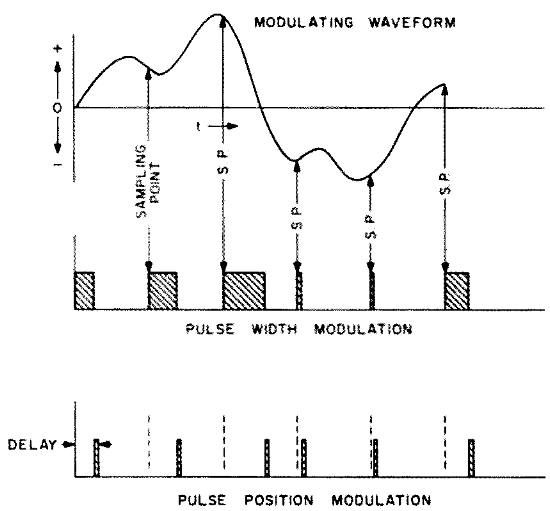


FIGURE 1

Before you go out and buy some big bottles, read on. The receiver must have a much higher bandwidth to handle this kind of a signal and therefore, its noise input will be higher. If we use a pulse which has a roughly triangular waveform, the receiver may have the minimum bandwidth. As the pulse gets wider, the receiver bandwidth may get narrower, so that as the peak pulse power goes down, so does the noise power at the receiver input. The sad truth is that for any practical combination of peak power, pulse width, and bandwidth, the power density which we may reach with this system is about 0.25 watts per cycle of bandwidth. Since this number may not mean much we shall develop similar numbers for AM, SSB, and DSB and see how they compare. But as you read, remember, if *peak power* would do the job, the whole world would be using pulse code communications. (Actually, a good portion of it is but for different reasons. A discussion of this subject is interesting but too involved to include here.)

Good Old AM

Let's look at AM for a minute. For 1 kw of carrier power we can put 500 watts in the modulation if we use sine wave modulation. But people don't talk in sine waves so the situation is somewhat different. Speech differs from a sine wave in the way in which its intensity fluctuates. Thus it is impossible to keep the level of modulation at or near the peak value without clipping.

What about clipping? Clipping helps in speech communications systems because all systems are limited by the hardware to the peak power which they may handle. By clipping, which we may also look upon as instantaneous AGC, we are merely smoothing out the peaks and valleys in our speech intensity profiles and enabling our transmitters to operate nearer their peak output for a greater percentage of the time. We are therefore, increasing the amount of the time when our signal will exceed the noise at some remote receiver. Clipping can be used to varying degrees with different types of communciations systems. With AM, very heavy clipping can be used. Even infinite clipping, or square wave modulation, is feasible and if you hide in one of the corners of some remote UHF band you can use such techniques; the splatter will keep you off the lower bands.

Just to give AM a real boost, let's assume

that we are using 100 percent clipping, or square speech waves. Now, instead of having 500 watts of audio packed onto our carrier, we have 1 kw. This divies up as follows: 1 kw in the carrier, and 500 watts in each of two sidebands. If we use both sidebands in the receiver, we have 1 kw of intelligence power (the carrier contributes no intelligence) spread over 6 kc/s or 0.167 watts per cycle. If the receiver has a 3 kc/s bandwidth and only uses one sideband, we have 500 watts spread over 3 kc/s or the same 0.167 watts per cycle. Without clipping, the power density is cut in half since we can no longer put as much power in the sidebands. Also, since the speech intensity will vary and we are limited to a peak intensity of 500 watts, the actual power density which we can achieve in practice is even less than half. Since "how much less" becomes a difficult question, let's just avoid it by assuming half. Then we can use 0.083 watts per cycle for AM with no clipping.

SSB

With SSB and an average input to the final of 1 kw then we will have just 1 kw of power to play with and if we are lucky, it will appear in just one sideband. (We will consider efficiency later). It doesn't matter whether clipping is used or not because it doesn't effect the average power one way or the other. With AM the power in the carrier is limited and we are trying to pack as much sideband power onto that carrier as we can. So we clip the speech to raise the average power that we can use without over-modulating. With SSB we have no carrier so we don't have the same problem. In fact, the only reason to consider clipping in the SSB case is that it might reduce the peak power demand on our linear amplifier.

Clipping must be used carefully with an SSB transmitter, however, since heavy clipping can actually increase the peak power demand on the final. Moderate clipping and filtering can be used successfully and if a high pass filter having a 6 db per octave roll off below about 800 cps is used ahead of the clipper with a low pass filter having a steep roll off above 2750 cps after the clipper, heavy clipping will give good results.

At any rate, clipping won't help us any here so we come back to 1 kw spread over 3 kc/s of bandwidth which gives a spectral power density of 0.33 watts per cycle.

DSB

In a recent article by W3PHL (73 Magazine, February 1963) quite a bit was said about the way in which the power should be delivered

to a DSB final and the way in which it should be measured. Just to set the record straight, the conclusion which described a DSB final that packed in 1800 watts of average power is just not consistent with the legal limit of 1 kw. It doesn't matter what kind of complex logic you employ to get to a conclusion, a watt is still a watt and if RMS sensing meters having 0.25 second time constants are used to measure the volts and amps, then the result will be true power input (thermal equivalent) to the final on the same basis as it is in the case of an SSB final.

So with 1 kw of input to the final we will have 1 kw divided between the two sidebands. Again clipping does us no good since there is no carrier to consider and the effect on the size of the final amplifier is the only consideration that might make clipping worth while. The spectral power density is 1 kw over 6 kc/s or 0.167 watts per cycle.

What's the verdict? So far the spectral power densities look like this:

AM (no clipping)	0.083 watts per cycle
AM (100% clipping)	0.167 "
SSB	0.333 "
DSB	0.167 "
PWM or PPM	0.25 "
AM (no clipping)	0.0624 watts per cycle

Efficiency

W3PHL assumed 75% for a class C amplifier and 60% for a linear. These figures are probably representative of the best current practice so let's keep them. Then the table shown above should be modified as follows (assuming DSB to use a high level modulator):

AM (no clipping)	0.0624 watts per cycle
AM (100% clipping)	0.125 "
SSB	0.18 "
DSB	0.125 "
PWM or PPM	0.1875 "

Look who wins now! (I wonder what kind of a fight this will start.)

Receivers

For reasons to be explained later, let's examine the whole situation for several different types of receivers. The most important practical cases would include bandwidths of 3, 6, and 15 kc, plus synchronous receivers. Since a synchronous receiver is already pretty complex, let's assume that it has a number of "square" filters which the operator can select for optimum reception of any given signal. Also, I like to give phase coherent receivers an advantage in signal-to-noise performance of 1.414 instead of 2 as is often quoted for them.

Watts per cycle of receiver bandwidth

System	Receiver			
	3 kc/s	6 kc/s	15 kc/s	Sync
AM (no clipping)	0.0624	0.0624	0.025	0.0882
AM (100% clipping)	0.125	0.125	0.06	0.176
SSB	0.18	0.09	0.036	0.18
DSB	0.125	0.125	0.06	0.176
PWM or PPM	0.093	0.187	0.075	0.264

Note: The pulse width used with PWM or PPM has been assumed to have been optimized for 6 kc/s receiver bandwidth to show the effects of non-optimum receivers on system performance. The pulse width could easily be changed to suit other receivers.

Conclusions

No one should be caught dead without speech clipping on his AM transmitter. If you can afford one, you should have a synchronous receiver. From there on, it is up to you. There really isn't much difference. Just remember that some judicious filtering will be required if you want to use PWM, PPM, or heavy clipping without splatter.

Discussion

OK, you say, so all this jazz is fine but what makes the SSB signals get out when the AM Signals don't? I think the answer to this is not to be found in the science of radio but in the practice of it. First, SSB is more complicated and therefore has been practiced more by the better educated and equipped ham, or by the ham who chooses to buy his rig. So the transmitter is probably a little better. Second, SSB addicts found long ago that that stability requirements forced them to pretty good receivers and this produced a sizable improvement all on its own. Thirdly, there is the subjective factor of not having all those heterdynes. Fourth, the convenience of VOX operation make the whole thing more enjoyable. These factors plus the "real" improvement due to SSB account for what happens—I think.

Now for the practical approach. Most of the preceding junk assumes that you have plenty of money, the whole band to yourself, and control over both ends of the circuit. But it is just not so in true life. Most hams have some purpose in their hobby. If operating is the one that interests them, they must operate with some other ham or hams. So each one has got to pick his intended receivers. If you like to talk to the SSB crowd, don't go on AM—you won't make it. If DX is your real aim in life, why not brush up on your code? (I'll bet you thought we would overlook CW altogether—didn't you?) If new things interest you, try DSB and consider building a synchronous receiver—I am.

That probably didn't satisfy many of you. Let's consider a different tack. You don't have a key to Ft. Knox so the cost per watt is important.

The grounded grid linear amplifier deserves special mention here. Its simplicity, low cost, and the fact that it can be "over 100% efficient" (remember that drive power also contributes to the output) make a strong case for transmitters based on this. Also the high price of high level plate modulators should be considered. These facts, coupled with the 50% duty cycle of average speech and the effect this can have on power supply requirements makes a very compelling case for SSB and DSB. Stated another way, the average ham has a better chance of getting the legal limit if he uses the lower cost SSB and DSB systems than if he uses AM. If he doesn't want a big voice but can be happy with 10 watts, then the picture changes and AM looks good. Don't ask me where the cross-over occurs!

Consider who you leave out though when you plan your system. Nearly everyone is now familiar with SSB tuning and nearly any reasonable receiver will do. Those with receivers that have at least one steep side to their passband can copy DSB, some won't even know that the other sideband is there. But those with wide conventional receivers can't copy DSB at all.

To summarize it all up, let's make some simple statements:

1) If you use AM, use plenty of clipping and filtering.

2) If you can afford it, buy or build a synchronous receiver.

3) Choose a system to suit your tastes, the mode your friends use, or the amount of money you have. There is scarcely 6 db between the worst and the best and a little time spent on your antenna will nearly always be more rewarding at less cost.

4) If "maximum effectiveness" really bugs you remember that the only reason we didn't include a big discussion of CW here is because it would shame everyone out of the place—you can pack in 5 watts per cycle without even starting to get fancy and at less cost than any other system.

5) Please forget all about PWM and PPM. They are hard to put to practice and the splatter problem is fierce. And think of the arguments this would start.

6) One of the things that keeps our hobby so active is the fact with all the scientific methods at our disposal, there are still no "right" answers to all problems and everyone can develop, practice, and talk about his own opinions and ideas.

. . . K6HJH

An Inboard Calibrator for the NCX-3

George Morton WB2MAH ex W4HUP

Photos by A. J. Spatafore WB2FGL

Many hours spent reading the myriad brochures on tranceivers resulted in the purchase of a beautiful new NCX-3. After careful unpacking and a brief inspection of the instruction book, I hooked everything up and put out a CQ on the low end of 75. "Get back in the phone band," said a voice. "But I am in the phone band," said I. "You are two kc out," replied the voice. Sulking, I tuned up on CW down in the Novice band and got a calibration check from a friendly novice who was all too pleased to tell me his crystal freq. For the time being at least, I was calibrated. As much as I hated to face it I needed a calibrator. My checkbook was still recovering from the shock of almost $600.00 spent on the NCX-3, power supplies and other accessories; so it was no surprise that another $27.00 wasn't readily on tap. Besides, I didn't like the idea of anything sticking out of the rig when I put it in the mobile. I would have to make a calibrator and then I could mount it inside the NCX-3.

National engineers used the shoehorn treatment to squeeze all those components into that little box, so there seemed to be no room for a calibrator—or any thing else. Consultation with my good friend, Jack Daniels, produced the opinion that normal mounting was out of the question. I guess this is the conclusion that National's boys came to or else they wouldn't have made provision for mounting one outboard.

Looking the problem over in a new light I found there was enough room for a small

chassis behind the meter. If the tube and crystal were installed horizontally instead of vertically there was more than sufficient space there. Digging through the junk box I managed to come up with all the parts except the crystal, I even had a piece of aluminum that could be cut to make a chassis. A call to one of the locals resulted in a swap of a pair of 6L6s for a crystal.

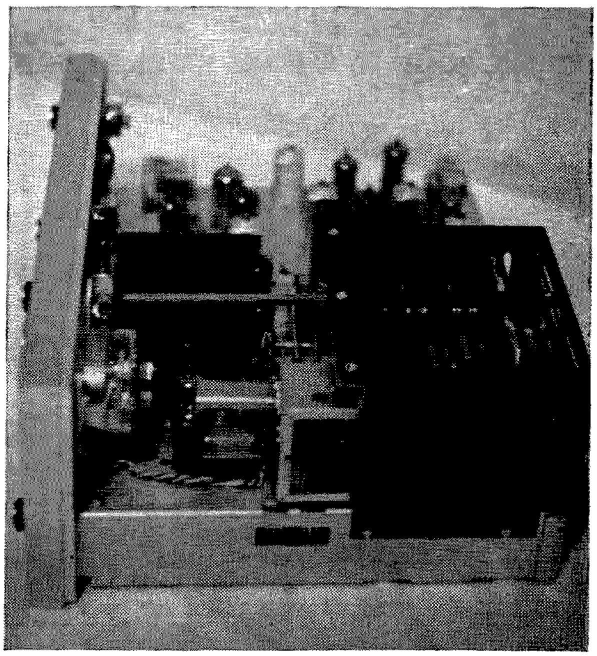
Chassis Construction

Cut a piece of aluminum to 6" x 2". Cut small notches 1¾ from each end on both sides, make these notches ¼" deep as shown in Fig. 2. Cut in ¼" from all corners, drill holes referring to Fig. 2. Holes for mounting the crystal socket are under *1*, the grommet hole under *2*, space for mounting C 1 under *3*, *4* is the tube socket cutout and *5* is the hole used to mount the terminal strip.

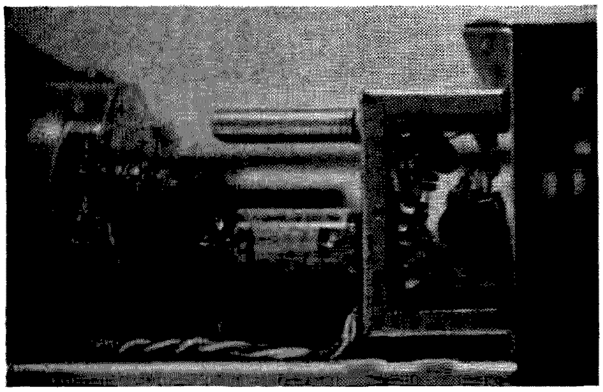
Bend the aluminum on the dotted lines as shown on the template, to form a chassis. Look at Photo #2 and you will see that there is a quarter inch lip all around, the lip on each end of the chasis as shown should be bent the opposite way so you will have surface to mount the calibrator in the NCX-3.

Wiring

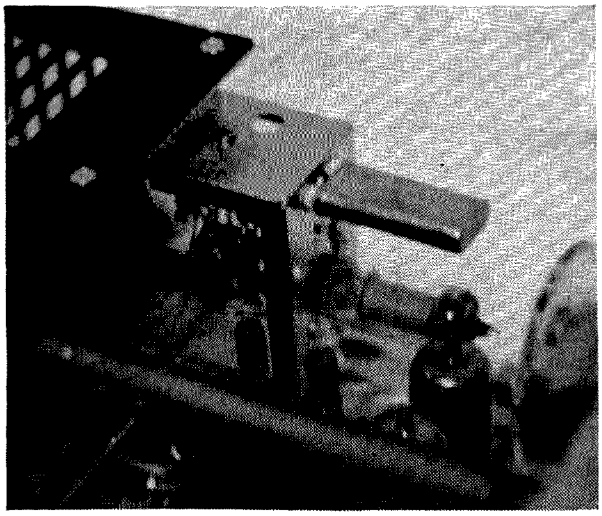
Mount the tube socket, crystal socket, terminal strip (3 term & ground), and the grommet. The type of trimmer you use for C1 will determine what size hole(s) you will need there. Mount C1. Run a small piece of bare wire



Just like in the sales brochures except something has been added behind the meter. Wiring from the calibrator can be seen running to the large hole under the meter for internal connections.



Mounting detail showing chassis placement. Change in position of crystal and tube in new installations (see text) is suggested.



The calibrator fits in perfectly, be careful not to hit those coils just to the left of the calibrator.

from one of the terminals on CI through one of the pins of xtal socket and to the ground lug on the terminal strip. Ground pins 2. 4 and 7 of the tube socket to the ground lug terminal. Mount C4 (10 mmfd) from pin 5 of the tube socket to one of the terminals on the strip. R3 goes between two of the terminals on

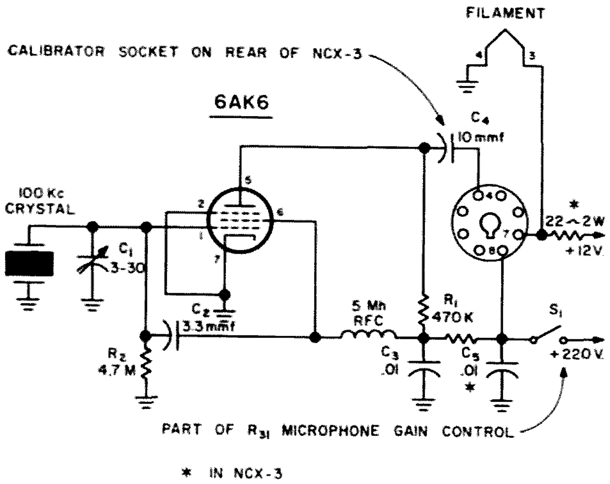
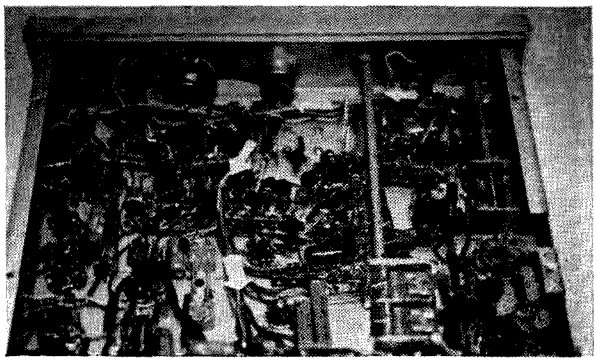


FIGURE 1

the strip. Finish wiring as per diagram Fig. 1. Solder a piece of #18 hookup wire 24" long to pin 3 of the tube socket. Three more 24" lengths are soldered to the terminals of the terminal strip; the ground lug, the B+ end of R3 and the output side of C4. These go through the grommet. Parts values and layout is not critical as long as reasonable tolerances are considered. LI should be mounted in such a manner that it is equidistant from all ground points for maximum output.

Installation

Not wanting to drill holes or otherwise foul up my new pride and joy, it was decided that a new means of mounting the sub-chassis would be needed. Glue was the answer. Yes, glue! Not model glue, but that expensive Dupont stuff guaranteed to hold two boards together so well that wild horses couldn't pull them apart. Thirty five cents will buy about 100 times what you will need to do the job, so maybe you can borrow some from a neighbor.



Under chassis wiring of the calibrator follows the wire harness (white arrows), the ground lead is connected to ground terminal next to hole in upper LH corner.

Apply a thin coat of glue to the areas to be joined and then press firmly into place as shown in the photos, with this exception; the tube should be on top and the crystal the bottom. This will protect the crystal from excess heat in your installation. I have had no adverse effects but if I had it to do over again I would do it the other way. Besides if you mounted it like I did you will have the grommet and wires feeding through it away from the chassis if you followed Fig. 2. The template was drawn with this revision in mind. Don't worry about the ability of the glue to do the job. I have had this rig in and out of the mobile and fixed set-up for three months now and it is as sturdy as ever. I haven't had a chance to get any wild horses yet, so I will make no promises on that account. The only problem with the glue is in getting an effective

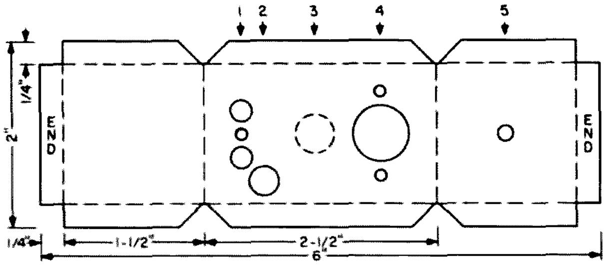


FIGURE 2

dc ground. This is why we ran a wire from the ground lug of the terminal strip.

After giving the glue time to set, run the wires from the grommet through the hole under meter. The photos will give you an idea of how it is done. Connect the ground lead to the ground lug on the first terminal strip you come to under there. Run the others toward the back of the chassis following the wire harness to the calibrator socket at the rear of the NCX-3. The little white arrows in the photo shows the way. The calibrator output lead goes to pin #4 of the socket, the filament connection to pin #7 and the B+ lead to pin 8.

Plug in the tube and crystal, turn on the power and you are ready to try it out. Allow a few minutes for things to cook a little, then pull the mic gain control out, this will apply B+ to the calibrator (a switch is part of this control for exactly this purpose). You should find a strong signal near one of the 100 kc dial divisions. Eureka, it works!

To zero the calibrator it is necessary to use a receiver capable of tuning WWV or a local BC station that operates on a multiple of 100 kc. Run a short length of wire from pin #4 of the calibrator socket in the NCX-3 to the antenna input of the other receiver. Zero beat and you are set. Be careful if you use ac/dc set and a BC station as your standard, you could get quite a charge out of the calibration. After zero beating your reference sig, button it up and you are in business, safe from fear of an FCC QSL.

. . . WB2MAH

Parts needed in addition to those shown in Fig. 1:
2 x 6 inch piece of aluminum for chassis
seven pin miniature tube socket
three terminal and ground terminal strip
crystal socket
Miscellaneous mounting hardware

Push-to-Talk for the HT-37

Rolf Carlson W2ZBS

When the background noises in the shack get unusually loud (two small harmonics running around), the author on occasion has wished for a push to talk circuit in his HT-37 for more positive control over the station's operation! Anyone who has used voice control (VOX) knows its susceptibility to sounds other than the operator's voice. In looking over the circuit diagram, it was obvious that a push to talk modification for this transmitter could be accomplished in several ways. However, the author desired a) the simplest and easiest modification, and b) no changes to the normal operation or appearance of the transmitter.

The modification to be described here requires installing a phone jack and a piece of hookup wire soldered between the phone jack and a terminal strip in the VOX circuitry. That's about as simple a change that can be made these days! (Fig. 1.)

Now that you see there is hardly anything to it, let's install the change.

First, before we do anything, look at the back of the HT-37. If your unit is similar to the author's (serial #259222), you will notice two ½ inch diameter unused holes, one near the 11 pin control outlet and one near the 50 ohm rf coaxial plug. The phone jack used in our modification is installed in the ½ inch diameter hole nearest the 11 pin control outlet. The next thing to do is to remove the top cabinet cover by removing the four screws on the sides.

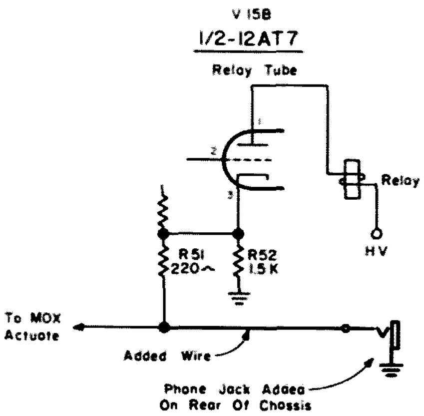


FIGURE 1

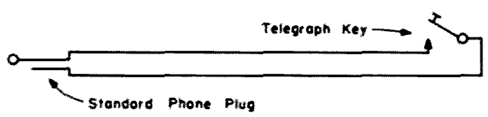


FIGURE 2A

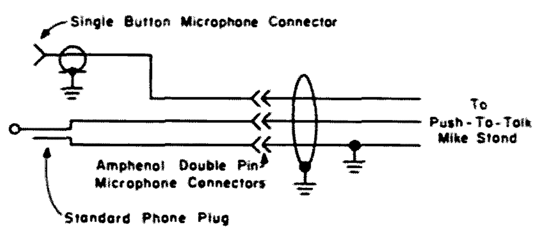


FIGURE 2B

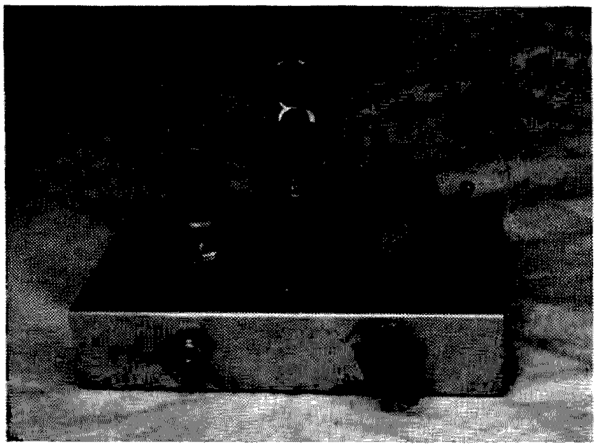
Then turn the transmitter upside down (after removing the 5R4GY rectifier tube so it doesn't get squashed) and proceed to remove the screws that fasten the bottom cabinet half. Now install the phone jack (make sure it is not the shorting type when the plug is out) and route a piece of hookup wire from R51 (220 ohm resistor) to the phone plug. Solder the wire to the resistor on the end opposite to where it is attached to the cathode pin 3 of VI5B (½ 12AT7). Solder the other end of the wire to the hot connection of the phone plug. Replace the cabinet halves, the rectifier tube and that's it.

Fig 2 shows two possible methods of use. (A) shows the simple expedient of using your telegraph key as a control device. With this method, the VOX sensitivity control is turned fully clockwise to prevent any audio from picking the relay through the VOX circuitry. All operation positions work normally except that in the VOX position the transmitter is put on the air with the closing of the telegraph key.

Fig 2 (B) shows how a cable with suitable microphone connectors is uesd with a push to talk mike stand. In this case, since the hot lead of the microphone cartridge is grounded when the push to talk switch is open (true on an Actatic model G stand), the VOX sensitivity does not have to be turned down. To use this method, just insert the phone plug in the rear, and the mike connector in its normal position on the front panel, and you are in business. If you should desire normal VOX operation again (after the kids have left the shack) just pull out the phone plug, lock the push to talk handle in the closed position and everything works as if nothing had been done.

That's it . . . a simple enough change to add another degree of versatility to an already fine piece of gear.

W2ZBS



The Gardner Modulator Revisited

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Peekskill, N. Y.

Soon after I passed my General Class exam, I searched for a simple and effective means of modulating my 50 watt CW rig. As I had not yet accumulated enough junk to make a plate modulator economical, some other form of modulation would have to do. I ran across the Gardner circuit in Volume five of "Hints and Kinks" and built the whole thing for less than five dollars, exclusive of tubes. It was my orginal intent to use this as an interim modulator until I could get something better going. The little thing worked like a dream and a slight modification of the original design made it even more effective. However, the time came when the lure grew too strong, and I built a plate modulator. The thing was large, heavy and noisy (the surplus modulation transformer *was* running a shade over its ratings) and, to my great surprise, showed no *noticable* improvement in modulation strength and quality when compared to the Gardner circuit in the same QSO. These tests were made over both long hauls with marginal signals and local work. When the shack was moved to the basement, I went back to the little cathode modulator and have been using it exclusively for over three years with consistent reports of excellent audio quality and good "punch." Its operating qualities and simplicity makes one wonder why it has been almost completely ignored for so many years.

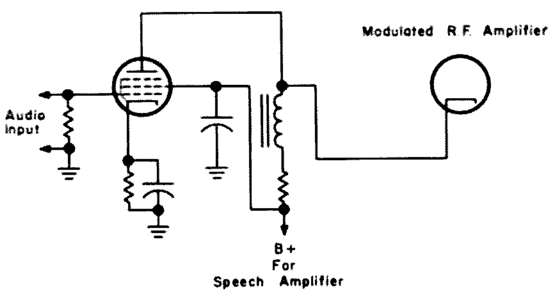

FIGURE 1

Circuit

The basic circuit is shown in Fig 1. It consists simply of a class A amplifier connected between the cathode of the modulated stage and ground. Modulation is applied simultaneously to the grid plate and the screen if the modulated amplifier happens to be a tetrode or pentode. This eliminates the need for a coupling transformer with its associated impedance matching problems and also makes it possible to eliminate the need for a separate plate power supply. In addition, high voltage for the speech amplifier is available through an audio choke and capacitor filter from the modulator plate. Thus, if supplied with filament voltage, the modulator can be "installed" simply by plugging it into the cathode key jack of the final amplifier. This makes it an attractive circuit for use with portable rigs and most inexpensive CW-only rigs.

Fig. 2 shows the complete circuit with a speech amplifier using a more modern tube than the original. In addition, a 500 ohm potentiometer has been added in the cathode of the 6Y6 for adjustment of operating conditions. The speech amplifier shown is for use with a high impedance mike. A carbon mike circuit is shown in Fig. 3 which has been used success-

fully wth an ARC-5 transmitter in stand-by and mobile service. With 1000 volts on its plate, the ARC-5 can be run at up to 100 watts input on phone. With currently available dynamotors delivering 1000 volts output, this combination makes a good choice for a powerful but inexpensive mobile rig if you have a husky electrical system.

Construction

It is only necessary when building this unit to keep all leads short which are going to the first speech amplifier stage and to shield the lead from the mike connector to the grid of the 12AX7. If rf feedback occurs, it may be necessary to filter the input circuit with a .001 pf capacitor to ground and an rf choke in the grid lead.

If the modulator is to be permanently stalled in the transmitter, it might be better to take supply voltages for the 6Y6 screen and the speech amplifier plates from an existing high voltage source in the transmitter through a dropping resistor. A switch, S-1 is provided to change the transmitter over from phone to CW. The circuit as shown is capable of modulating an amplifier whose plate current in this

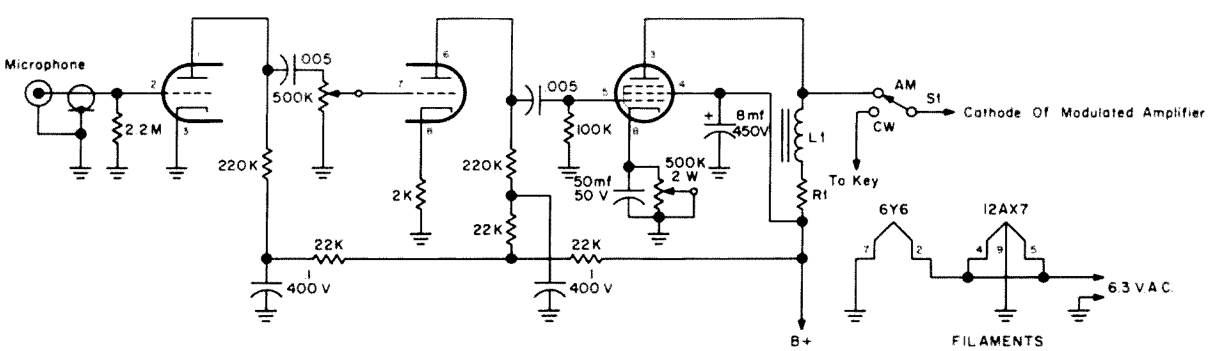

FIGURE 2

L1—any small audio choke, 2h or more or the plate side of a small output Transformer

R1—nominally 2000 ohms, 2W, adjust to higher valve if 6Y6 screen voltage exceeds 135V

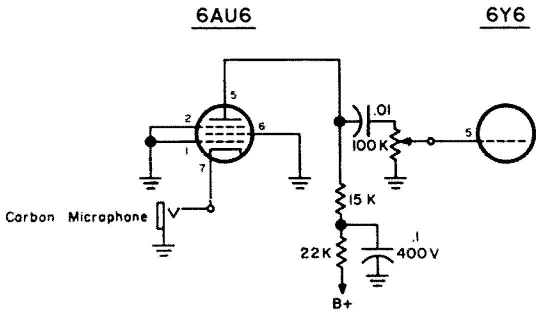

FIGURE 3

mode of operation does not exceed about 100 to 120 ma. To find this current for your transmitter, look up the recommended plate modulated conditions for your final tube at the voltage available and use about 80% of this value. If this is over 120 ma as mentioned above, use two 6Y6 tubes with all elements tied in parallel.

Make sure, at any rate, that the maximum screen voltage of the 6Y6 (135 volts) is not exceeded and that the plate voltage of the 12AX7 does not exceed 300 volts. Be sure to check these voltages on standby as well as when the transmitter is under full load as on occasion these might be exceeded by quite a bit and you will be wondering where all the 6Y6's are going.

One more word of caution: be sure, especially when working with fairly high voltages on the final, to apply filament voltage to the 6Y6 before any high voltage is applied to the final. This will be taken care of in most rigs if the filaments of the modulator are tied in with the other filaments or are at least arranged so that they come on when the others are turned on. In arranging phone—CW switching, do not remove filament voltages from the modulator when operating CW lest you inadvertently switch back to phone and immediately apply high voltage.

Adjustment and Operation

Adjustment, once you get the hang of it, is almost as easy as plate modulation. After checking for errors and the usual smoke test, tune the driving stays in your transmitter for normal grid current in the CW position. When you switch in the modulator you will notice that the pot in the cathode of the 6Y6 controls the final plate current to a great extent. This is where this particular circuit differs from the original. Adjust the plate current using this control to a point somewhat below the rated operating current and tune the final for maximum output as indicated on an rf voltmeter, ammeter, FSM or scope. Bring the plate current up to the value determined earlier in the article and advance the gain control while speaking into the mike until there is a flicker in the plate current on voice peaks. If you have a scope available it would be wise to adjust the modulator until some clipping action is seen. If the plate meter is observed to flicker downward or clipping appears on the scope before any appreciable upward modulation takes place, increase the loading to the final or decrease the plate current with the cathode pot, or both, until more upward modulation is indicated on the scope or the plate current is observed to flicker slightly upward.

It will be difficult to note a dip in plate current as the final tank is tuned through resonance with the modulator in the circuit and you must use some means of indicating rf intensity to tune up. This can be anything from a 9c neon bulb to a Bird wattmeter as long as you can tune for maximum output. Don't worry about blowing your final during this process as the modulator will prevent excessive plate current.

At this point you should conduct a test with a station who is receiving you about S-9 on a QRM-free band to determine that your signal is free of hum, noise, distortion and splatter. Once this test is passed, you are ready to enjoy many trouble free QSO's—and if you don't tell any one that you're not plate modulated, they will never know.

Now Hear This Fellow Amateur

Frank Phillips W4LCY
Bangkok, Thailand

Recently, there have been several notable amateur personalities who have expressed their views concerning the fate of amateur radio. Generally speaking, all of the views have made one thing clear, and that is, the amateur will have to increase his value toward public service in order to maintain his existence. Many qualities and quantities were noted and pointed out which over the years we amateurs have taken for granted and as a result, has caused us to lapse into a false sense of security.

In looking over the ham bands in their present state, it is quite obvious from the way the frequencies are being utilized that a general up-dating is in order. Progress can be made in technical achievement, operating proficiency and proper use of equpiment. I agree with one author in that the frequencies are being used to a great extent in "projecting personalities" rather than in something more constructive. It is all too true that many amateurs are more adept at buying their equipment instead of building it, with the consequent loss of technical ability. No doubt this is the aftermath of "our times" and the fact that "getting on the air" has been made too easy. However, the purpose of this article is not to review what has been said previously, but to point out that the amateur is not the only one lacking in incentive and regardless of how perfect, or valuable we may become, it will have little bearing on the outcome of future international conferences. If this bit of information shocks you, then the forthcoming information is intended to enlighten you.

Previous discussions on this matter have been glaringly superficial as they have tended to place the amateur in a poor light while supporting the other inhabitants of the frequency spectrum as being faultless, infallible and above reproach. Nothing could be further from the truth. We are all familiar with the fact that there are two sides to everything. Let's take a look at the other side. The side that various spokesmen are reluctant to bring out; depicting the typical human trait of deliberately avoiding the responsible issues, or not being adequately informed on the subject to a point where they can speak factually.

For some time now, the amateur service has been a sore point with a number of countries who would much prefer to see the ham bands used for other purposes. This is not to say that they would use the frequencies for the general welfare of the international public, but it is to say that they would like to see them used for *their* purposes. It is a well known fact that there are countries who are completely hostile to an amateur service. It would not be difficult to comprehend this source of hostility if you were to closely scrutinize the basis for this state of mind. You will find communications systems that are inefficient due to poor engineering, there is a shortage of trained personnel to operate these systems, there is opposition to acceptance of new and better modes of communication, there is no insight to any problem related to communications, they do not abide by the edicts of the ITU, (except on paper), and communication posts in their governments are filled by political appointment rather than on the basis of technical competence. They have never contributed to the art, and furthermore, they never will. They are quick to tell you that there is no need for them to delve into research, or experimentation, when they can purchase what they need on the open market. From the foregoing, one can deduce that this is not a healthy environment for the support of an amateur service. They just don't want any. They point out that the added load of an agency to handle amateur

affairs and monitoring of the ham bands constitutes too much of a bother to warrant an amateur service. What they don't tell you is that they would much rather allot the frequencies to business enterprises because of the added revenue in taxes that would be available. How can you possibly sell them the idea of having amateur radio when their outlook is mercenary. It is impossible. So what happens at an ITU conference? They vote against an amateur service! The only way that they would possibly vote in favor of amateur radio is that if there were something in it for them. Something tangible, that is.

It is a little known fact that in trying to cope with the frequency problem, one of the retarding aspects to a satisfactory solution is that many representatives do not "see" the problem as those who are more versed in communication engineering from a standpoint of long association or experience. In other words, the human factor is more of a governing agent than an enginering one. Just because a person is from the other side of the world, he doesn't comprehend the problem the same way that you do. How the laws of physics, or the requirements of an engineering necessity can be altered by human whims has always been the primary negotiating obstacle at an international conference. Nevertheless, it's there.

Also another ironic reality is the fact that many countries whom we have to cajole at the conferences, are, or have been in the past, recipients of technical aid in one form or another. Although original impetus was lacking in the initial stages of radio communication, they are now "experts" in the field and they are now in the position to vote prohibitively concerning amateur radio affairs. I would also venture to say that if some of the representatives at the ITU conferences are indicative of many of the communication officials in governments whom I have encountered, they haven't the faintest notion of the history, achievements, or functioning of an amateur service. This means one thing which is a natural defense when ignorance prevails. If you don't understand it, or don't know what it is; vote against it!

In looking over some of the reasons why he non-amateurs have their cold, envious eye on the ham bands, you will find that most of hem are about as ridiculous as they can be. As a beginning, there is this notion of public service. A close look at the frequencies being used for shortwave broadcasting will reveal hat in the true sense of the word, they are not being used wholly for a public service. Would an intelligent person admit, for exam-

ple, that Radio Moscow with their type of broadcasting constitute a public service? Let's not be naive. Take any one country as a hypothetical case. Can it be said that the broadcasting of their "virtues" to the rest of the world be in complete accord with a public service. Public service to whom?

It has been pointed out that nearly thirty new countries have come into being as brand-new nations in the past few years, with a strong feeling of pride in their newly found sovereignty and a desire to broadcast their virtues and philosophies to the rest of the world. Is a desire for broadcasting of mere virtuous and philosophical beliefs a truly valid justification for adding more congestion to the present enunciations on the frequency spectrum? Very few possess technical background sufficient to intelligently sanction modes of communication to fill their needs. Regardless of their capabilities and shortcomings, however, they are allowed to vote at a conference.

This brings up another point. It was further proclaimed that in order to foster democracy, this is the way it has to be done. With no reference to technical background, every nation has a vote. This one aspect alone is the reason the frequency spectrum is in a sordid mess. The allocation of frequencies is no longer a result of necessity, or engineering endeavor, but rather one of politics. Vulnerability to political stratagems is the prime reason for the state of the frequency spectrum today. This must be true, obviously, as the present state of frequency misuse will substantiate this. The complexity of frequency shortage and frequency misuse presently on a world wide scale is due more to a human factor than a technical one.

Another so-called factor that was brought to our attention was the need for a country's "vital" communications. Monitoring the high frequency bands will further reveal from that which is propagated it is extremely difficult, if not impossible, to differentiate between the "vital" and the inconsequential. Shortwave broadcasting for informative purposes is no longer a necessity as it once was. Even in remote countries people are watching TV programs and not listening to shortwave broadcasting. An objective look at this service will determine conclusively that the multitude of stations are not an absolute necessity. If radio communications is not a toy, or a hobby, then why is it being used indiscriminately in the broadcasting field?

Some learned minds have said that the so-called leading nations have to go along with what is available in the way of administration, otherwise chaos will reign. What is the higher two-thirds of the forty meter band in the Western Hemisphere if not chaos? In some areas of the world the eighty meter band as well as the forty meter band is chaotic! Ask those who have lived in Asia about the state of the frequency spectrum there. From the low end of the broadcast band to 30 megacycles it is a shambles. For the "authorities" who have never gotten any farther from the continental limits of the United States than to Geneva, the use of the frequency spectrum as it shouldn't be used has already been ushered into that part of the world. Whether a BC receiver is available or not, it makes no difference. A shortwave receiver will fill the bill nicely as the second harmonic of any BC station can be received with no drop in quality. Harmonic filters are just two words in a textbook. If you don't know better, you would believe that the raucous CW signal was a status symbol in Asia. The accepting thing is the signal with 130% modulation. It is virtually impossible to use the time standard stations WWVH and JJY on 10 megacycles because of the commercial RTTY stations riding on top of them. If you desire to use any particular frequency the usual method to to tune up, the more power the better of course, and then sit on the key for a few days. After you have driven everybody off, you have a clear channel. Every local shortwave broadcasting station has a VFO. As the QRM builds up they shift their frequency in an effort to find a clear spot. That is, if they can find one. Frequency allocations? That's kid stuff.

There is one country in Southeastern Asia with which I am thoroughly familiar. The size of this country is about that of Texas. Do you know how many BC and SW stations it supports? Believe it or not, 70. That is a seven and a zero. Seventy. That's not taking into account the military, government and private businesses who have their own networks. The number is staggering. Now mind you, that is only one country. Multiply that to account for *all* the stations in Asia and Africa. The ITU? Oh yes, that's in Geneva, isn't it?

In summation, the over-all picture of the frequency spectrum indicates that control through present administration is no longer effective. The situation will become progressively worse as time goes on. More and more new stations are clamoring for space which is already non-existent. The countries who are not members of the ITU will use frequencies they deem necessary. The others who are members will agree to the recommendations as long as they are present at the conferences, or if it serves

their purposes. Once they return to their bailiwick, however, they will follow the dictates of necessity. Responsibility will be hard to come by when they feel that they are being detrimental to themselves by abiding by the regulations.

Eventually, the amateur frequencies will be completely taken over. The process has already begun since the last conference and as a portend of things to come, commercial stations are continuing to encroach on the amateur frequencies. When the final encompassing will reach the final phase is a difficult item to peg down. It may be a long drawn-out process, or it may not. It can be anybody's guess. Regardless of the amount of conjecture, it is inevitable. Those of us who shun the idea, or refuse to accept the fact are living in a cocoon.

In time to come, the commercials will create enough of a problem so that the congestion will become thoroughly inhibiting and it no longer can be ignored. They will finally realize the need for control and only then will there be a general agreement for frequency allocations. The leading nations of the world, technically speaking, are already aware of this and have been for a number of years. These are not the nations who will have to be convinced. As soon as the "battle of the megawatts" begins, it will finally dawn on nonchalants that something is wrong. Every nation cannot afford high power, nor will they be able to cope with it. When enough of them become "educated," they will then raise their voices in protest for changes to be brought about.

There has been talk that if the amateur service were abolished there would be a resultant solution to the frequency shortage problem. In my estimation, the only solution it would bring about would be of temporary nature, if any. Any individual who proposes that the present dilemma can be rectified by discontinuing the amateur service, is stating the fact that he is not qualified to contend with the matter. Abolishment of the amateur service is not a logical solution to the problem, and moreover, it never will be. There are many things that can be done to alleviate the problem of frequency shortage. Will they be done? I doubt it. At least not in the foreseeable future. There is the matter of politics, present equipment in use, the huge amounts of capital required to convert to other means, conflicting viewpoints; to mention a few reasons. There is also a matter of an enforcement body which doesn't exist. Parallel to the influence of a well-known amateur organization, the ITU in its present form has worn out its usefulness. It has no power. The entire organization functions on a "gentlemen's agreement" and with the present world situation being what it is, there are fewer and fewer gentlemen.

What does all this mean to the radio amateur? It means that the amateur may have to share frequencies with the commercials. I use the word "may" because it is possible that ham radio may become a historical era. It is quite possible that the United States along with other leading nations will retain the amateur allocations altho the amateur will be forced to operate with the foreign commercials. Then again, we may be forced into the VHF, UHF and the higher frequency bands. It all depends on the whim of our government and the FCC. It is also highly possible that they may scrap us to pacify the foreign governments. This would not be at all surprising, to say the least, when considering the present outlook in a political sense.

I am aware of the fact that I have painted a rather cynical and dismal picture regarding the future of amateur radio and the present state of affairs, but the identifying facets are prominent. As a DXer I cannot see how DXing, as we know it today, can flourish when the avalanche begins. Altho our government may take the open-minded view, there are many governments who will not. Exit the DX station.

Narrowing it down to our own country, we have one salvation the way I see it. Our military. In the event the FCC forsakes us, I sincerely believe that the military will come to our rescue. The reason I believe this is because if there is any agency that recognizes the value of ham radio, the military does. Just ask the United States Navy what they think of the amateur in regard to their operation in the antarctic. Just ask the military what they think of a pool of ready-trained personnel during national emergencies. Where else can they lay hands on personnel for their needs, or the needs of industry manufacturing military equipment. At the present time with their MARS programs they practically give you the shirts off their backs. Many military installations sport complete ham shacks provided by special services. If we experience complete loss of our frequences, it is quite possible that the military will open blocks of frequencies presently under their jurisdiction. Another way they would look at the situation is from the standpoint of training. What finer experience for counter-insurgency work can be had than by operating and moving traffic among high-powered commercial stations. Ask the Special Forces, fellow amateur. I hardly think that

the amateur service will be completely abolished in our country. Not as long as the military has the task of defending our ideals and there are dedicated men in charge of the armed forces.

Getting back to amateur incentive, the amateur is really not the guilty culprit after all. If he is lagging in incentive it may not be of his own making. The framework under which we function is not totally due to the amateur's desire, but to the bureaucracy's. In spite of all this, the amateur has made many contributions to the art and will continue due to his very nature. He is not really behind in achievements when considering that many of his noteworthy achievements were not products of super-educated brains, or multi-million dollar laboratories. In less technical terms, the amateur is continually contributing to international good will by his congenial conversations with amateurs of other nations. Is this a public service? What could be more important in this day and time. What about the amateur's contribution during emergencies where the lack of professional participation is noted by their absence.

I belive we amateurs will take care of our own, as far as incentive is concerned, because it is imperative that we do. If it is too much of a strain, then we ought to turn in our tickets. Many factors have been pointed out in the past that can be improved upon. One of the more important items is the conduct on the part of every amateur. Cooperation during the movement of emergency traffic will have to be increased. There is no excuse for deliberately causing interference during a crucial time. Another important point, is our "image" in the public's eye that could stand a lot of improvement. If we are to survive, then we need all of the help we can muster. As an amateur, make yourself worthy of help.

. . . W4LCY

FOREIGN SUBSCRIPTIONS

The foreign subscription rate to 73 is $4.00 U. S. per year, however we will accept cash or checks in foreign funds at the following rates:

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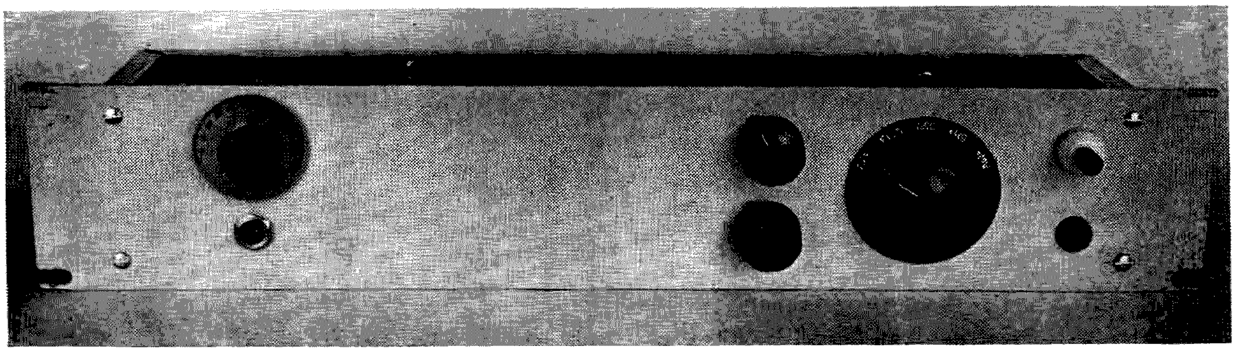

Frequency Standard

Robert McGraw W2LYH
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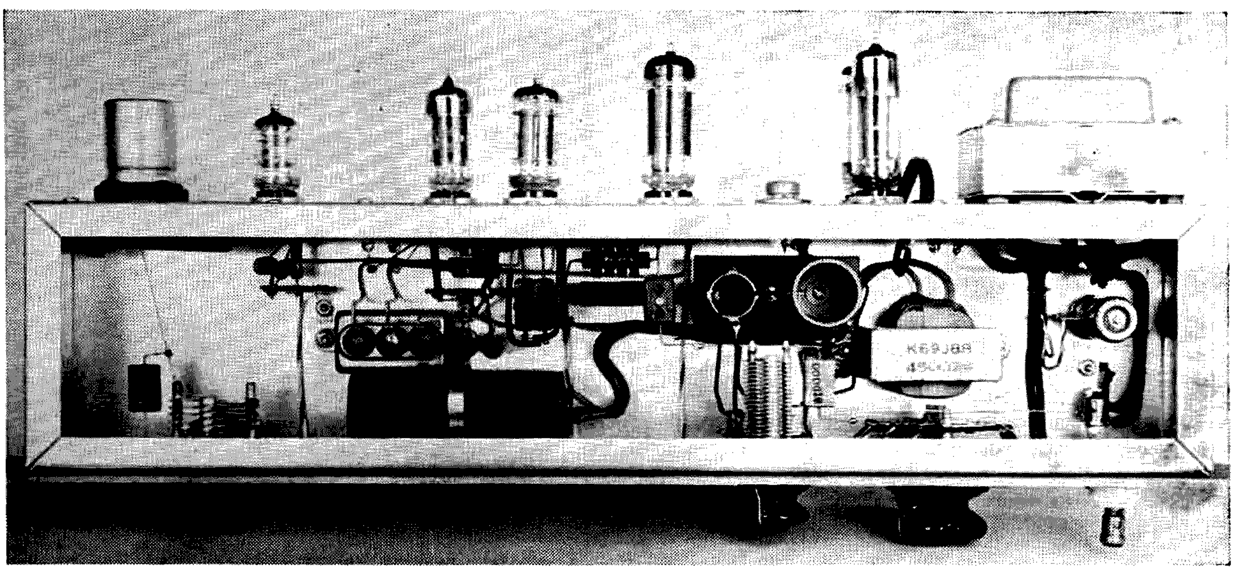
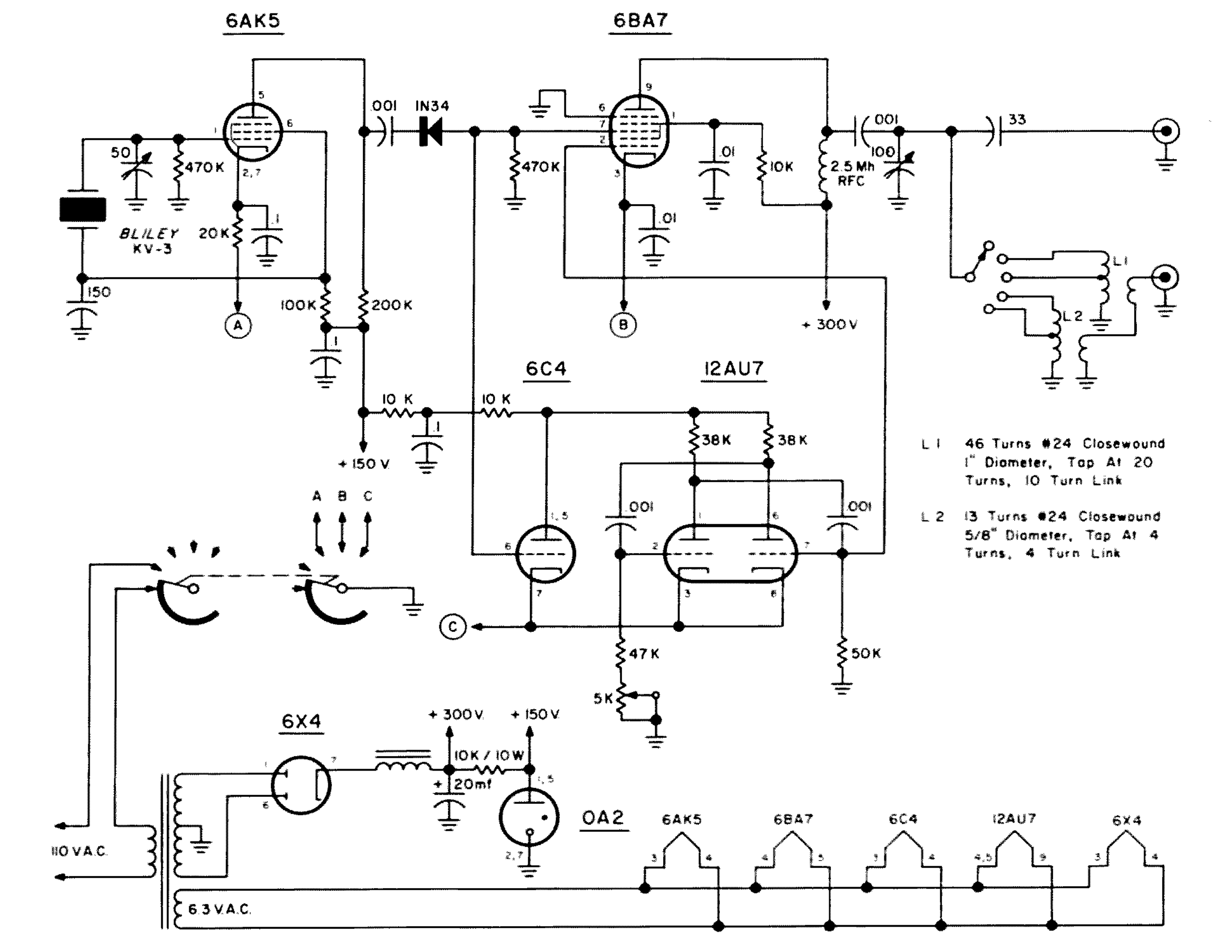
Some sort of frequency standard is, of course, a necessity in every ham station. The usual 100 kc crystal oscillator, while fulfilling most requirements, can be made much more useful by the addition of a 10 kc multivibrator and harmonic generator. There is nothing like those 10 kc markers for calibrating the dial scale of that new receiver or VFO which you have just built. In several previous frequency standards, I had trouble keeping the multivibrator locked on 10 kc. It seemed that whenever I wanted to use it, the multivibrator was working on 11.111 or 9.090 kc. This difficulty has been eliminated in the present model—the multivibrator stays reliably locked on 10 kc. For dividing the 100 kc by an even integer, in this case 10, the synchronizing voltage should be fed to both multivibrator plates in phase. This is accomplished by the use of the 6C4 buffer tube, which acts as a Heising modulator on the 12AU7 plate supply. The harmonic generator is a 6BA7 pentagrid mixer, which gives excellent isolation of both input grids from each other and from the plate cir-





6AK5
6BA7
001
IN34
470K
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20K
BLILEY KV-3
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A
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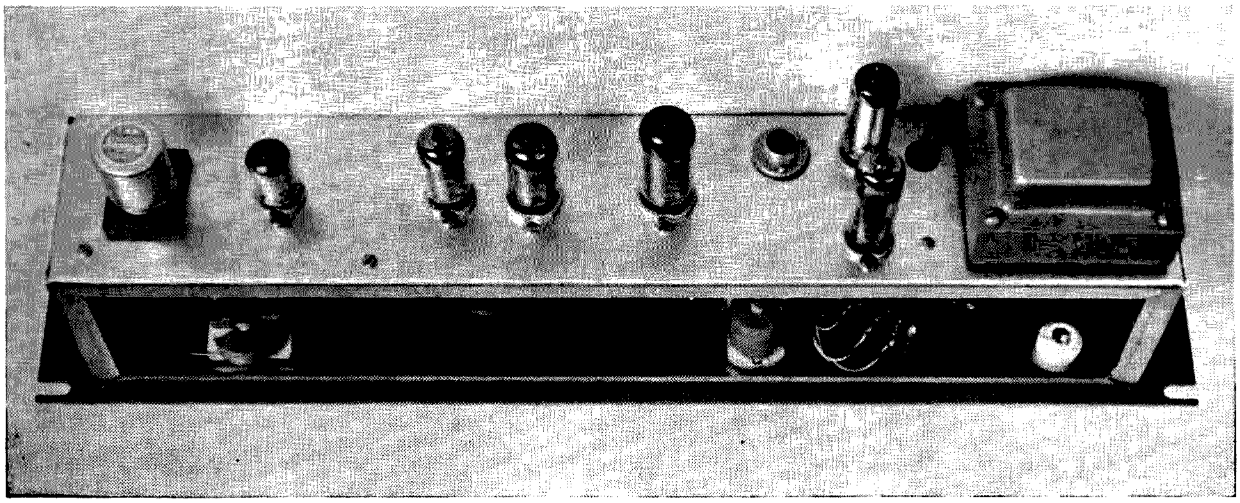
10K
2.5 Mh RFC
001
100
33
+300V
L1
L2
6C4
12AU7
10 K
10 K
38K
38K
+150 V
001
001
47K
5K
50K
6X4
+300V
+150V
10K / 10W
20mf
OA2
110 V.A.C.
6.3 V.A.C.
6AK5
6BA7
6C4
12AU7
6X4
L1 46 Turns #24 Closewound 1" Diameter, Tap At 20 Turns, 10 Turn Link
L2 13 Turns #24 Closewound 5/8" Diameter, Tap At 4 Turns, 4 Turn Link



cuit, so that the oscillator frequency is not affected by switching the multivibrator on or off, nor by tuning the output circuit. The crystal zero-adjusting trimmer and the multivibrator adjusting pot are brought out to the front panel, as are the harmonic generator coil switch and tuning capacitor. The output functions are controlled by a two-pole five-position progressive shorting switch. In position one, the ac power is off, position two turns on the filaments, position three turns on the oscillator, and positions four and five cut in the harmonic generator and the multivibrator respectively. The low-impedance output is fed into the coaxial antenna input system of the station receiver, and the high-impedance output terminal is used for general purpose testing and calibrating.

Jim Kyle K5JKX
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Oklahoma City, Okla.

More on the Vertical J

Our previous article on the "so old it's new" Vertical J antenna may have left the impression in some quarters that this quick and easy (also inexpensive) VHF antenna was strictly for Six.

Nothing could be farther from the truth. The writer's first acquaintance with this skywire was on the 2-meter band during a sojourn in 6-land, where it helped provide fairly consistent communication from Los Angeles to San Diego.

And the 2-meter version of this antenna bears special mention, because it can be fabricated rapidly from standard commercial components—and even used on your mobile if you don't mind looking like something from interplanetary space.

Because, you see, a standard 6-meter whip is exceptionally close to ¾ wave long at 144 mc, and of course the 19 inch "catwhisker" rooftop vertical for two is a quarter wave. If you just mount the catwhisker on a sheet-metal plate (or the roof of your auto) and fasten the 6-meter whip an inch or so away, you have the beginnings of your 2-meter Vertical J.

To have a true J, both antennas should be grounded and the balun feed described in the previous article should be employed. However, many West Coast enthusiasts ground only the ¾ wave element and feed the ¼ wave catwhisker in the conventional manner; they report no noticeable degradation in performance, and any SWR problem is cleared up in a few minutes with dykes at the end of the catwhisker. Not according to the book, but they say it works FB!

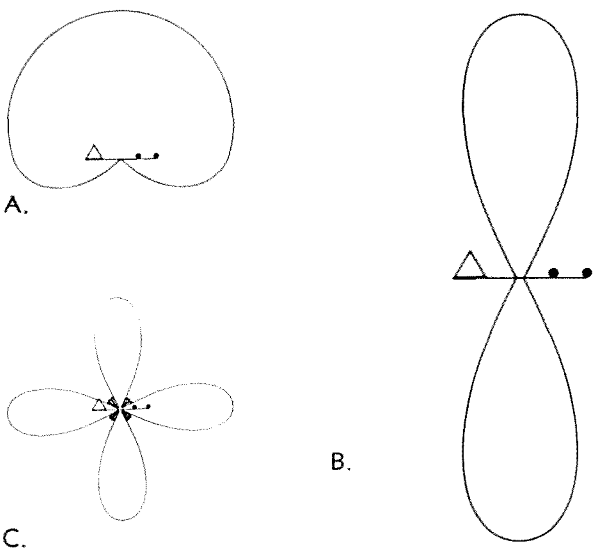
Another possibility with the J not mentioned in the previous article concerns the idea of side-mounting one on your existing beam tower. If properly done, this can provide you directional characteristics (this, admitterly, overpowers a characteristic previously cited as an advantage—but a good cloverleaf pattern frequently is more useful than a perfect circle, if you can get a few db of gain in the cloverleaf).

Three patterns are available: cardoid, bi-directional, and cloverleaf. The cardoid pattern is achieved by mounting the antenna ⅛ wavelength away from the tower. The null will be on the line running through both tower and antenna, on the side of the tower. The bi-directional pattern (a rather sharp one, by the way) is achieved with a ¼ wave spacing. The lobes will be at right angles to the line running through both tower and antenna, and will be of approximately equal strength.

The cloverleaf pattern occurs with half-wave spacing between tower and antenna, with one lobe spotted on top of each of the lobes of the bi-directional case, and the other two lobes halfway between. The nulls of this pattern are usually not very deep, making it the most useful in many cases.

These three patterns are sketched in Fig 1, not to scale. For the benefit of the technically inclined, here's what happens. The tower is a metallic object (if it's not, this trick won't work) and is sufficiently long that we can consider it not to be resonant. To a surprising degree, it acts like a metal reflector, producing an effective "image antenna" on the other side. This "image antenna" then combines with the actual J to produce a 2-element broadside array, and the patterns cited are determined by the spacing between the elements of this "array." Sounds screwy but it works out in practice, and is widely used by the commercials operating in the VHF and UHF regions to avoid the purchase of beam antennas when they need directionality!

. . . K5JKX



A. ⅛ wavelength spacing from tower
B. ¼ wavelength spacing from tower
C. ½ wavelength spacing from tower
Side-mounting Antenna Patterns, not to scale.

Big Brother, and How he Grew

(or House of Seven Gables, Ham Version)

Milt de Reyna K4ZJF

Throughout the RM-499 ruckus, one fact has become increasingly evident; simply, it is this: probably in no other field do advocates of the art know as little about their governing body as do Amateurs, as a group, about the FCC. Though this agency holds the power of life and death over Amateur Radio, not one ham in a thousand knows enough about it to carry on any sort of a discussion concerning the Commission's operations—and you can't really blame the average ham for this sad state of affairs, for amateur publications have never attempted to publish any sort of a primer on the FCC. A searching analysis of the Federal Communications Commission would, at this point, require the better part of a year to compile— but a ready working knowledge shouldn't be too difficult to acquire; this article hopes to provide a start. First, however, let's try to provide a few ground rules that will help writer and reader understand each other, to wit: the writer pretends no claim to amateur fame, and doesn't intend to lecture anyone on what should be done. However, he has worked for fourteen years in commercial broadcasting, and has had to learn to live with the FCC; this experience just might provide you with an insight to what is going on that may be worth having. The reader's part of this agreement will involve his doing two things—first he will read the comments on Ivan Loucks in Wayne's February Editorial, then he will turn to page 81 of the same 73 and read the essence of Ivan's mesage in Bill Orr's letter. He will memorize what Mr. Loucks has to say about the apparent confusion between personal and public interest, and will stare in awe at the term 'problem children'; he will read the last sentence concerning the standard against which the wisdom of continuing our allocations will be measured, and then he will try to learn something about the agency which will make the measurement, which brings us to the start of this article.

The Federal Communications Commission was created by the Communications Act of 1934; it's purpose is simply to regulate in the field of communications, whether they be by wire or radio. It is an arm of and is responsible to the Congress—it is most definitely not a Presidential Advisory Committee, or anything of that sort. The Commissioners themselves are nominated by the President, but are subject to confirmation by the Senate. Most important is this one fact—theoretically, the Commission is not subject to political influence on any one matter, or conflict that comes before it for disposition. In other words, your friendly Congressman just might do you more harm than good if he tries to pressure the Commission on the matter you have before it; and decisions that can be shown to have been involved with undue influence are subject to overturn at any time. However, the policies and guidelines the Commission uses are very definitely subject to revue by Congress—yearly, when the agency submits its budget request for the forthcoming year. This is the point where political influence can be decisive in charting the path the Commission will follow for the immediate future.

As you read what follows, keep one word foremost in mind—defensible. In the set up of the Commission, there is a well defined chain of responsibility, which starts at the level of the staff, and extends all the way up through the Commissioners, to the appropriation committees, to Congress as a whole, and eventually to John Public. At each level, matters are considered with the thought in mind that the decision will have to be defined at the next link in the chain, the eventual necessity being that of Joe Congressman justifying to the aforementioned John Public the Commission's operation during Joe's tenure in office. The Commission, therefore, is never going to hand Joe a decision that cannot be justified as being in the public interest—the majority must always be served (there's better than 180,000,000 of them and

250,000 of us; remember that, too).

In the pre-war years, the Commission's basic responsibility was the encouragement of the providing of communications facilities to the public; from its inception until approximately 1947, the Commission was basically a passive regulatory agency; it ruled on matters brought before it, but it made no attempt to lead the broadcast or commercial communications industries in any particular directions, preferring to let the normal needs of the marketplace be the central determining factor in the goals that were to be set.

The end of the war marked the appearance of an entirely new set of circumstances, and resultant pressures, from what the Commission had ever before encountered. AM broadcasting boomed, there were more applications for new stations than the Commission knew what to do with; and, some interesting, albeit prohibitively expensive experiments with black boxes that made pictures were beginning to present some most interesting problems.

AM frequencies have always been controlled by supply and demand; it was the applicant's responsibility to determine whether he wanted to apply for a local, regional, or clear channel frequency; to produce the necessary engineering studies to prove that the new facility could be built without representing serious damage to the service areas of operating facilities, and to show that the new facility would represent a service to some segment of the population living in the area in which it proposed to operate. When all these criteria were met, the applicant could reasonably expect a Construction Permit to be issued.

At first, television was to be handled on the same basis; but, the changes later produced by the impact of Television, which are still having their effects today, are the real meat of this article, and will render a pretty fair picture of general Commission thinking.

At first, the Commission set up three classes of Television Stations—Local, Regional, and Rural with service areas that are obvious—and planned to let the laws of supply and demand take care of how many stations would wind up where. But, they did not reckon with the impact that TV would produce and the resulting fantastic demand for frequencies in large metropolitan areas, nor did they reckon with some unsuspected defects in paper engineering and the profusion with which Old Sol produced in the maxima of 1948. The result was a freeze on TV construction permits which was to last until 1952—there were 108 TV stations either operating, or under construction at the time the freeze was imposed. The purpose of the freeze was to allow time for further research to find ways to avoid the serious interference problem, and to study posible methods of frequency allocation, which would provide the best possible service to the maximum number of people.

During this period, the Commission was subjected, rightfully, to all sorts of demands from the elected representatives of areas that did not have operating TV stations to end the freeze; meanwhile, the impact of TV became obvious, and all sorts of interested lobbies showed up asking to be heard. The educational interests made the loudest noise, and the CBS-NBC battle over whose standards would be accepted for color ran second only by a snoot. The result of all of this was a radical departure by the FCC from prior standards, and the adoption of allocation tables and an "everyone is equal" philosophy. (Does this sound familiar). Maximum operating conditions were

assigned to Channels 2-6 and 7-13 that attempted to make the service areas of each equal; the newly opened UHF channels were assigned maxima of 1,000,000 watts hoping to make them competitive with the VHF facilities. Prospective licensees were given time to prepare their applications, and standards for deciding competing applications for the same channel were enlarged and redefined. All of the above detail is set down to give the reader a good idea of just how rough a spot the Commission was on, and on the type of solutions that were proposed to form the most painless solutions. The competition for the Channels was fierce, and the pressure from the public to get, at least, some of them operating immediately was worse; the Commission was caught right square in the middle, and it emerged in the late fifties as an entirely different breed of horse from what it was when it first entered the TV arena. What was once an obscure small agency, was now the center of attraction; everybody knew there was an FCC, it had something to do with television, and would it please stop fooling around and get Back Bay's channel on the air.

Television grew in alarming steps, and knotty regulatory problems, in addition to competitive hearings, grew with it; as it became involved in one crisis after another, the Commission became more of a Crusader for the creation of new Public Services than a Protector of the conventional areas of Public Interest—this was later called the New Frontier. Gradually, the Commission began to chart new courses into areas that had never before been its concern—type and source of programming, sales practices, etc., all have come in for their share of attention. It was inevitable that the Commission should eventually incur the wrath of Congress, and start procedings looking toward the limits of the area in which Congress intended for the FCC to act. To go further would get into speculation and assumption, warranted or otherwise, which are areas we agreed are out of bounds for me. So lets sum up what we now know about the FCC, and then devote a few moments to projecting this new posture of the FCC into the middle of the chaotic situation that is Amateur Radio today.

We now know, I think, the following:

1) The FCC is today a vibrant agency that has defined clearly what it thinks is its mission. It has moved far enough towards the area of Public Utility regulation that there is now a serious move within Congress to accurately define the limits of the FCC sphere of decision.

2) The agency is almost fearless in moving to correct what it thinks are abuses in areas where there is no question of its authority to regulate. Within the last six months, the FCC has revoked, for cause, many licenses, one being an AM Broadcast that was worth over $1,000,000. The former licensees of this station lost over $900,000 in the revocation, and you just can't minimize the seriousness of a penalty of this sort. The action speaks eloquently for itself.

3) Television is getting most of the attention today for the simple reason that the Commission considers this the greatest area of need, and the greatest area of possible reward. It's easy to throw all sorts of mud in this area of motivation—by all means draw your own conclusion on whether these men are motivated primarily by laudable ideas of public service, or not so praiseworthy purposes of personal publicity—but, accept my assurance that these ideas and methods will one day get around to ham radio. (Go back and read Mr. Loucks' last sentence again). Frankly, I hope you're fairly well shaken at the moment; I hope you're wondering where the hell we go from here. Stop and think—the average family spends about eight hours a day in front of the idiot box;there's no question but that TV today provides the bulk of the average man's entertainment, yet, the FCC has not hesitated to tackle problems that go to the very root of the institution of commercial television as we know it. They are dealing with the basic entertainment of over 180,000,000 people—an industry whose size goes into billions, and not even the Commission's worst enemy will accuse it of being gutless. Idiotic maybe, but not cowardly. Now, in that context, just how important do you suppose our earthshaking little squabble about incentive licensing.

Since you're drawing the conclusions, let me ask the questions—

1) Realizing what the justication for the existence of amateur radio is, how do you suppose the FCC is going to react to the thousands of letter it has received damning the ARRL for the incentive proposal because of contrary personal interest. These things usually start by saying "The ARRL certainly wasn't acting for me when they filed. . . ." Mr. Loucks had already had, obviously, a pretty good dose of this when he made the QCWA speech. How do you suppose he feels now?

2) Has this squabble soured the Commission on the ARRL, and raised serious questions on its credentials as Ham Radio's spokesman? Regardless of what it thinks about RM-499, does the Commission consider the way the petition was handled with the result-

ant controversy as being prima facie evidence that the League is not all it says it is? If true, will the Commission seriously question whether the ARRL will still command enough prestige and repect to keep Amateur Public Service projects glued togther, or will the FCC get into this area itself? Are we likely to encounter more interest from the FCC in the future as to just how much of our operating time each of us devotes to Public Service? Will we have to file a Public Service narrative and a list of the organizations to which we belong along with our next license renewal.

3) Especially in view of the emergence of the Citizen's Band, do we need a lobby in ashington? Had we better see that each elected Senator and Representative gets a running monthly commentary on the Amateur contributions to Public Welfare made in his district in the past thitry days? Would we like o have the House Appropriations Subcommittee express concern, at the annual budget hearings, to the Chairman of the FCC about his plans to enhance the Amateur Service during the coming year.

4) Finally, do we have every reason to expect that the FCC is liable to step into the current breech with rulemaking proceedings of its own, which may make the ARRL's proposal look like kindergarten poetry? Have we divided our own house and become prey not only to commercial interests but even to the Citizen's Banders?

We need leaders; we need men who, out of the current conflict, can construct a simple brick house that no wolf can blow down. We need to stop selling each other on our record of Public Service, and take that record to someone who can do something for us. Maybe Wayne's new IoAR is the answer; maybe this can all be straightened out inside the ARRL. Certainly, we'd all better calm down, and quit thinking about only our own interests. and devote some thought to how best to do the things Ham Radio needs done.

Immediately above Mr. Loucks' comments in the February 73, page 81, there is the end of a fine article by Dana Griffen; probably, like me, agree with some of the things he says, disagree with others—but, this last paragraph is a pip, isn't it? How about 1296.5234mc, our lowest frequency band, on January 26, 1970, at 1430 GMT? Should be a wonderful round table.

. . . K4ZJF

Eric Young K7KYG
Kent, Washington

Amateur Radio Emergency Service

Yeoman service was performed by radio amateurs in the recent earthquake disaster in Alaska. A number of Alaskan amateurs worked long hours without respite to clear outgoing messages to relatives of people living in areas affected by the earthquake. They were not helped by some thoughtless hams in other parts of the U. S. who kept trying to QSO. One ham (WB6FRM) even tried to QSO with CW on the SSB frequency. Most, if not all, of the traffic was cleared on SSB. Monitoring the CW segment of the 20-meter band showed no KL7's clearing traffic, but a number of amateurs busy with the DX CW contest sponsored by the ARRL.

Of note was the length of time required to transmit each message on phone, in spite of the fact that ARRL message numbers were used instead of text. Much time was taken for spelling out of names of addressees, streets, and towns using phonetics. There was also need for frequent repetition in the case of street and telephone numbers.

Assuming that an operator can transmit reasonably good morse code at speeds around twently words a minute, it should be possible to clear mesages of the ARRL number type at a rate of fifty or sixty mesages per hour. It would have neded only half-a-dozen good operators to handle both outgoing and incoming traffic over the week-end. As things were, very few incoming messages were accepted by the Alaska amateurs on Saturday and Sunday.

Amateurs in general should learn some lessons from this disaster. Fortunately, comparatively few people lost their lives and the number of injured was small. This could have been due in some part to the small size of the affected towns. BUT let us suppose that a city such as San Francisco were the center of an earthquake of similar proportions. With power lines down, no telephones operating, water and gas mains broken, and sewers out of service; hotels, apartment houses, dwellings, and office buildings demolished; streets cracked and warped, and numerous casualties; could the San Francisco amateurs carry out an emergency communications operation? Just imagine the colossal number of messages that would need to be handled.

Supposing that a sufficient number of amateurs were equipped with gasoline powered generators (and supplies of gasoline—the gas pumps don't operate without ac supply) just how many stations could be accomodated on the phone segment of any band, even if all were working SSB and assuming that no thoughtless or inconsiderate hams in other parts of the country were attempting to make QSO's (or maybe a DX 'phone contest might be in progress)? One can imagine that there would be a H--l of a mess! UNLESS some kind of control can be worked out in advance ready to be put into effect under emergency conditions.

It is true that we have ARRL Section Communications Managers and Emergency Coordinators right now, *but* I have my doubts as to whether any EC has ever been given instructions as to his duties and responsibilities. The average ham doesn't know who is authorized to handle emergency communications in his area or what action he should take in the event of a local disaster.

These matters require immediate action—*the next earthquake may not wait too long before it strikes. It may be S.F., L. A., OR N. Y.* Who knows?

. . . K7KYG

Correspondence from the Members

Letters we bet you won't see in QST

Dear O. M.:

I would imagine that as manager of the ARRL, you participate in and bear a large portion of the responsibility for determining League policy; as such, RM-499 must be a result to a great extent of your thinking—considering the chaos sired by your brainchild in the past six months, do you not feel just a bit foolhardy in commenting on that thought processes of someone else? Again, assuming that the current posture of the League is largely your creation, do you know of anyone with less license than yourself to characterize another as "irresponsible"? Have you not mistaken your pinafore for a toga, or are you prepared to compound your position by claiming that you anticipated the bitter situation that has resulted?

I'm sorry you learned nothing from reading my letter three times; you're the first I've run across who had to read it more than once to get the message. It is true that the only answer to that letter would have been a detailed retort to the direct questions raised—your epistle of Feb. 25th begs the issues in the same manner Mr. Hoover did; we can play ring around the rosy for the next month, but I'll be damned if you're going to outlast me by answering questions other than the ones I asked. Let's try to reduce the issues to simple statements, and see what happens then:

First, I agree with everything the League has said about Incentive Licensing; I also believe you are honest in claiming that about half of ARRL's members support the concept. I am diametrically opposed to the ARRL plan; I have heard many others which would achieve an Incentive Licensing structure through a, seemingly, more logical, more palatable and less dangerous course; the broad outline of a couple of these plans is included in my last letter—what I asked for was an analysis of why the ARRL plan is better than the ones I referred to. You have replied with a reference to your defense of the concept of Incentive Licensing; Mr. Hoover used the same tack—in a Court of Law. you'd both be ruled out of order for producing answers that are not responsive to the question; however, since we have no such authority as a judge handy at the monment, I suppose we can waltz each other around until one of us drops from exhaustion. Why is the ARRL plan better than any of many others that would achieve the end of setting aside portions of the bands we now have for Advanced Licensing, and would leave, at least, some room for current Generals to continue phone operation on all bands? Now, don't reply to that question by launching into a defense of Incentive Licensing; don't cloud the issue with nonsence about lousy signals, public service, ITU, IARU, allocations conferences, etc., all of which may be problems, but they are not germane to the matter in question. Assuming that Incentive Licensing is to be desired, WHY IS THE PLAN THE BEST? WHY DID YOU SETTLE ON A PLAN THAT WOULD REMOVE ALL INSTEAD OF A PORTION OF PHONE FREQUENCIES FOR GENERAL TICKET HOLDERS? This is what I referred to in my last letter by asking for the origin of and reasoning behind the ARRL plan; neither you nor Mr. Hoover has yet provided nything on the plan itself that is worth the cost of the aper its written on; this is the issue you have consistently voided, and the one you won't come to grips with now. gain, you are being asked to defend ARRL's plan for establishing an Incentive Licensing structure—you are not being asked to defend the concept of Incentive Licensing.

Now, let's try to add one more thought; personally, I don't believe I'm competent to render a truly meaningful judgment on which plan is best, for I'm simply not in possession of enough information; though I'm opposed to your plan because of the severe hardship it would work on many licensees, I'm aware that there may be cogent reasons arguing for the acceptance of your plan—these reasons are what I've spent the first four paragraphs asking for. However, I do feel qualified to make the judgment that you have botched your program beyond all reason; no entity that engages in commerce of any kind with the Federal Government would never knowingly create a problem within its ranks and then ask the government to solve it. You've done this, either by intent or accident, and you haven't sense enough to understand yet the position Amateur Radio is left in because of your miscalculations. I believe that unless you can cure the dissension in the ranks, you may have outlived your usefullness; based on current FCC thinking, I don't think it is going to be too interested to exert the firm leadership you asked for, which was merely a thinly disguised plea for this agency to fish your chestnuts out of the fire for you. Are there any answers to these questions—can you justify your current posture, or are you going to reply by telling us all about hundreds of problems that have nothing to do with this one.

Regarding your comment about my letter to you being published in 73, this was as much of a surprise to me as was Wayne's original quotation of my remarks in his February issue; he was certainly within his rights to use them, but they were not originally written for that purpose. However, when you challenged me on the basis of something I said months ago before you drove your latest bull through the china closet, I had no choice but to let him know what was going on—I could not take a chance of embarrassing him by leaving him in a position where he could be caught short on information. And, since we're discussing his irresponsibility as well as mine—and yours—he ought to have a copy of this also. He may be off base in a couple spots, but, I'm beginning to think his overall ideas are correct—and, his suggestions for reorganizing the League seem to me to be pure genius.

Milt de Reyna, Jr., K4ZJF
Pensacola, Fla.

Mr. Richard Baldwin W1IKE
Assistant General Manager
American Radio Relay League
Newington, Connecticut
Mr. Baldwin,

I have your letter of February 25th and resent it greatly. In the first place you are making an assumption that anyone who disagrees with you feels ". . . that their own personal ox is being gored." Whereas if you had payed the courtesy of reading my correspondence regarding my resigning from ARRL you would have noted that it was because of ethical considerations.

My resignation occurred because I thought ARRL was not loyal. Reversing "The Amateur's Code" momentarily, "The ARRL owes its existence to the Amateurs and offers them unswerving loyalty." This, Mr. Baldwin, is the other side of the coin. There is no such thing as one-way loyalty. Loyalty is reciprocal moving in both directions for mutual reinforcement. Without loyalty from the League, there is none due it.

This lack of loyalty on the part of the league was shown not by others but by the July 1963 editorial in QST. To avoid misquoting I am gving the entire paragraph—

" 'I thought the league was supposed to represent my interests.' It does, but the best interests of over-all amateur radio are not necessarily the immediate personal interests of each individual. Over the years, the ARRL Board has taken a number of actions which were unpopular with many members at the time, but which proved to be the wise course."

As I read this paragraph, I believe the crux of the matter lies in the word -'represent" which ARRL is reading in one

of the lesser accepted connotations rather than the more common one intended. In other words the answer is not a true answer but a changing of the question to a "strawman" question and then answering the altered question. "Webster's New World Dictionary of the American Language" College Edition, 1956, p. 235 lists the following definitions and I would call your attention to the fact that the preferred definitions have a lower numerical order. (Italics are shown by underlining.)

"1. To present or picture to the mind. 2 a) To present a likeness or image of; portray; depict. b) to be a likeness or image of, as a picture or statute is. 3. To present in words; describe, state, or set forth; often to do so forcibly or earnestly, so as to influence action, persuade hearers, make effective protest, etc. as, he represented *the war as already lost. 4 a) To be a sign for; stand for; denote; designate; symbolize; as x* represents *the unknown. b) to denote or express by symbols, characters, etc.; as* represent *mathematical quantities by letters. 5. To be the equivalent of; correspond to, as in a different place or time; as a cave represented home to these people. 6 a) To present, produce, or perform (a play, etc.). b) to play the part of; impersonate (a character), as in a dream. 7. To act or stand in place of; be an agent, proxy, or substitute for. 8. To speak out and act for by duly conferred authority, as an ambassador for his country or a legislator for his constituents. 9. To serve as a specimen, example, type, or instance of, exemplify or typify."*

The person who objected, probably was using one of the earlier more common definitions whereas in your answer you used either the 3rd of the 8th one.

For the moment let us consider the 8th definition, leaving the third till later. In one of my letters, which apparently was not read, I pointed out that legislators are interested in what their constituency thinks. In fact I enclosed a copy of one legislator's attempt to find out. I think, also, it is customary for ambassadors to wire, phone or find out by some means how they shall represent their country.

In the FCC petition ARRL claimed to represent amateur radio or rather the amateurs. Any ambassador who was not certain that he was expressing the wishes of his country, or a legislator expressing the wishes of his public would certainly back away and take another look at this proposed course of action. At least I hope he would—I would hate to think that our Moscow representative might plunge us into war because of a foolish error on his part, particularly when advised he was not expressing the desire of the country. I do not feel I am getting the type of representation I wish so, rather than back a point of view quite alien to my own and not having other recourse within the League, the only ethica thing for me to do is to resign.

Now I should like to point out that if I represented the ARRL view as only the 8th definition, I would be fulfilling the third definition and I would be representing the league in this sense. This type of action both of us would agree was quite unfair representation, yet if this is the definitiion under which the league is taking action, at least I *think it is unfair representation. Those who object to the action get the ". . . that their own personal ox is being gored." treatment. The same sentiment of calling the opposition nasty names was used in that same July editorial ". . . the immediate personal interests of each individual." The implication here is that the opposition is a selfish fool. He certainly does not know as much as the wiser ARRL Board. The phrase ". . . but which proved to be the wise course." implies also here is some outside criterion (beyond the judgment of those who decided) that determines this wisdom. The criterion source is not mentioned and it is rather difficult for people who have made a decision not to pat themselses on their backs and say how good it is. . . . .*

Now let us take a look at ". . . but the best interests of over-all amateur radio . . ." It would seem to be the responsibility of any organization to draw the members into closer agreement, to lead them and create unity instead of disunity. The action of ARRL has created more disunity in the membership than any other thing within amateur radio during recent times. THE EASIEST WAY TO LOSE SUPPORT FROM OUTSIDERS, WHETHER GOVERNMENTAL OR INTERNATIONAL, IS TO PRESENT A DIVIDED FRONT. Mr. Baldwin, this is exactly what the League has done. It has split amateur radio when we most need a solid front. Our losses in future conferences are apt to be due more to this factor that ARRL has caused than to any technical skill which might or might not be increased by such a plan. If you think the above is an overstatement, just ask someone who has done lobbying, whether the unity of the group of their technical skills are more important in getting legislaion moving and approved. If you do no know a lobbyist ask a legislator. The question the legislator must face (particularly where there is outside opposition, is, should be support one faction or another? The usual response is that if the group members can't agree among themselves they do not deserve support from others.

I was somewhat surprised to see in your letter that you considered incenive licensing a step forward. I seem to remember something similar in the '30's though I was not a ham then. I have a nice new shiny call but I cut my teetth in radio on "Practical Wireless Telegraphy" by Elmer E. Bucher, Wireless Press, 1921 and "The Wireless Experimenter's Manual" by Elmer E. Bucher, Wireless Press, 1920 when they were new books—and I still have them. I still have an affection for Mother's Oats Cartons and Variocouplers. I have read a few more books too. I am not afraid of new theory examinations and I'd be willing to take them too without any preparation. I do strongly resent though the loss of privileges of a large group through the action of a possible minority group. I think there is an ethical problem here which does not seem to have been considered by ARRL. I think the important problem is not, as you say, "maintaining the pace" but the ethical one mentioned above.

As I said in the opening sentence, I greatly resent your letter. Not onily do I resent the name calling but I resent the part that reads "If we weed out all the extraneous comment, if we disregard all the side issues and red herrings that have been dragged across the trail, we find there is one basic goal which amateur radio must *achieve—. . . ." You are implying that the opposition is resorting to distortion and distraction if not actually being dishonest. The purpose is to detract from ARRL's proposal. I should like to point out these implications do not seem very gentlemanly, they impute bad motives to the opposition. Incidentally, in "The Amateur's Code" have you noticed the phrase "He never knowingly uses the air for his own amusement in such a way as to lessen the pleasure of others."? I think it becomes very interesting if we substitute ARRL for "he."*

. . A third reason for resenting your letter, Mr. Baldwin, is the very basic philosophy which is expressed. The concept that the few know so much more what is good for the majority than those who make up the majority is quite a long way from the basic philosophy of the United States which holds to the different point of view that—the will of the majority determines elections, determines issues in initiative, legislatures, committees and throughout our society. When the ARRL takes the stand it will not consult its members wishes, even where there is reasonable doubt considering the wisdom of their stand, then it is not following a democratic method.

I really would have preferred not to write this type of letter, Mr. Baldwin, but one such as yours cannot go unanswered without concurring with your comments and I definitely do not concur. A letter such as yours is very ready to place the blame for the consequences of the League's action elsewhere. It blames everyone who gets in the ARRL's way. The opposition is not trying to use a red herring tehnique as you say, but is examining some issues which seem to be real—fully as real as the necessity for incentive licensing seems to some. To say the average amateur does not know what is good for himself is a pretty serious indictment, paricularly when it goes along with implied name calling and impied low motives.

Richard H. Earhart K7NTE

Editor(s) of QST,

I am writing to protest what has recently become obvious even to a novice, namely your flagrant disregard for honesty, sportsmanship and good taste in your handling of the controversy over RM499. Please note, I am not calling this a controversy over incentive licensing. In my opinion it is not—and this is the first point on which

you are less than honest with your readers and members. Many of us (myself included) favor other incentive licensing plans, but think this RM 499 has too many disadvantages—including emotionalism stirred up by ARRL's method of presenting it.

Your misrepresentation of the basis for much of the opposition to RM 499, besides dishonestly representing the opinions of your correspondents, is dishonest and unsportsmanlike in that it eliminates all possibility for discussion in QST of other proposals for incentive licensing. I would, myself, prefer some variation of the widely-discussed plan to cut down the portion of each band devoted to CW and use the NEW phone bands as an incentive for extra, advanced, or other superior class licenses—perhaps with distinctive calls for each class also. I have seen this discussed in other magazines, I have heard it discussed locally and on the air. What honest and sportsmanlike reason can QST have for never mentioning it?

An important violation of honesty, sportsmanship and good taste pertains to the letters from readers printed in your magazine. Those who read only QST surely must have a vivid picture of those of us who differ with the ARRL opinion as wild-eyed fanatics tearing up membership cards, stamping on ARRL handbooks, and screaming "I hate you—I quit!". Luckily for me, I do not read only QST. The letters I read in other portions of the amateur press are quite rational, from whatever angle they approach the subject. Your selection of the letters you publish which disagree with your position is, I therefore claim, dishonest, unsportsmanlike, and in very poor taste (for instance, I know of no other magazine except the "He-man" types which will print profane or obsene letters—even with dashes inserted in the obvious places.)

A final (as of this writing) violation of sportsmanship, honesty and good taste was the first paragraph of the editorial in April QST. It is neither necessary, honest, nor fair to call the editor of a disagreeing publication names when his information differs from yours, nor is it in order to cast doubts on his competence—especially in such a top lofty and condescending manner. Wayne Green at least is an individual, quite openly stating an individual opinion (and finding room in his magazine for those who disagree with him); and QST, as the official publication of the ARRL, would do better to answer some of the questions he raises, instead of noticing him only when name-calling seems safe. Frankly, I would like to see some of the answers.

To end this on a better note, let me say that I would not for the worlds resign my ARRL membership. I value many of your services too highly.

Martha Pruitt WN4OI

Letters

Dear Wayne:

I was at work when your "Vice-Presidency" interview came over the NBC line. Rather a surprise. "That's Our Leader," I sobbed, nervously stuffing my wig in my mouth and kicking the last QST under the console. Really a creditable performance, although you quite forgot to mention Geneva and Incentive Licensing. Congratulations, nevertheless.

Ken Cole W7IDF

Dear Wayne,

I joined the IoAR for $1.00 but I will find the other nine dollars hard to get to send you because I am on total Social Security Disability pension and you know how much you get from that. But I promise you I will send you the balance as soon as I can to help you carry on and do my share.

I enjoy your magazine very much, so keep up the good work.

Maurice E. Grenier WIGJL

Dear Wayne,

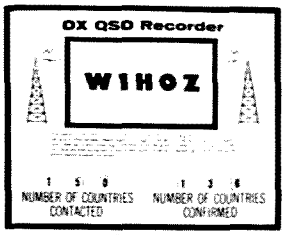
The ARRL sent me a card asking me to renew my membership. I returned it with the following note: "Gentlemen, I will not rejoin the League because of your proposal to take away my privileges on the phone bands. Go sit on a tack." I don't know if I am the only one, but I won't support an organization that I feel is working against my interests.

Carle Conway WA6TGC
Covina, California

Our recent poll showed that roughly 20% of the ARRL members feel as you do. Time enough to rejoin when they've straightened themselves out.

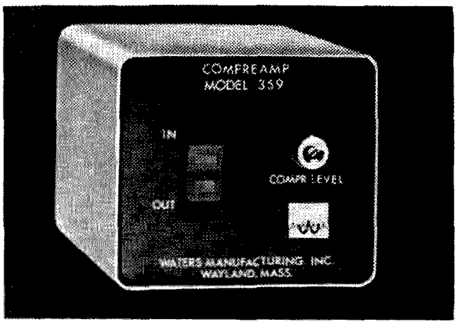
New Products

DX Recorder



One thing we like visitors to know right away is how many countries we've contacted. W1HOZ has come up with a brainstrom, a DX QSO Recorder. This is a heavy 8 x 10 wall certificate that explains about DX chasing and (by turning spinners) you show just how many countries you've contacted and how many have sent you QSL's. Good deal for $2.50. Viking Products, 196 S. Main, Orange, Mass.

Waters Compreamp

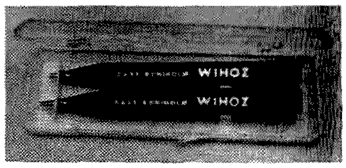


Bob Waters and his crew have been at it again. This time they've put a compressor and pre-amplier together and coined the word Compreamp tm (tm means they've registered the word). This unit will not only increase the effective output of a transmitter about four times without distortion, but can also be used with public address systems and recording systems to give higher average output power. Weak sounds are amplified and strong ones are limited. Self powered. $27.95 less battery. Don't miss the Waters catalog: Waters, Wayland 73, Massachusetts.

432?

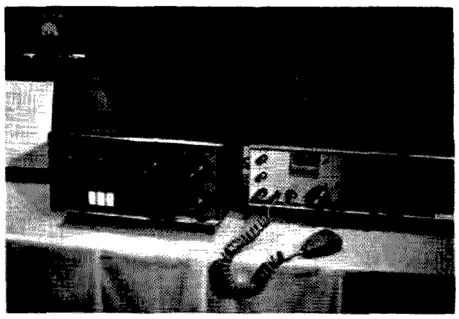
One of the simplest ways to get up to 432 these days is to put a tripler on the output of your two meter transmitter. The just announced VHF Associates tripler will handle 20 watts input and give 12 watts output. It is powered by the rf input. Price is $54.95 wired and tested, $49.95 in kit form. Write Box 22135, Denver, Colo. 80222 for info. You plug this on the end of your Gonset and away you go on 432.

Present



What do you give as a thank you when a ham does something nice for you? Or maybe puts you up on a visit. Yes, that's right, a subscription to 73. Or you could send along a pen and pencil set with his call and name on them . . . $4.50 from Viking Products, 196 S. Main, Orange, Mass.

National Linear



Mike Ferber of National made eyes pop at the SSB show in New York by demonstrating how he could drive a kilowatt wattmeter off scale with the output of this new linear. It's designed to operate with the NCX-3, naturally. Buy one right away.

Alignment Generator

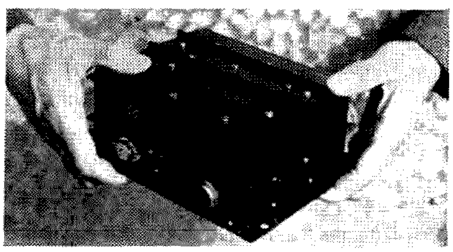
Texas Crystal came up with a fine idea. They have a little self powered three crystal

oscillator. It comes with your choice of nine *if* frequencies . . . for $29.95. For a little extra you can use any crystal from 200 kc to 3 mc. This ought to be great with 455 kc, 200 kc and 1000 kc. Write for spec sheet: 2100 Crystal Drive, Ft. Myers, Fla.

North Dakota QSL's

The North Dakota Economic Development Commission has an idea that might be of interest to other states. They've made up some mighty nice QSL cards for the Grand Forks Amateur Radio Club and now are offering them to any other interested amateurs in North Dakota. The card talks up N. D. and will be read with interest by everyone who gets one. N. D. hams should write the Commission at the State Capital, Bismarck.

Frequency Stable Power Inverter



Quite a few mobile power supply problems are solved when we put in an inverter which changes our 12 volts to 120 vac, allowing us to use our regular built in ac power supplies. Linear Systems has a new inverter that is great for this. It puts out 120 volts at 60 cycles ± 0.5 cycles over the range 12-15 volts input. This means that it will run even the clock on your rig, or a tape recorder with excellent accuracy. A patent has been applied for the new circuit involved . . . no tuning forks. For more info drop a card to Linear Systems, 605 University Avenue, Los Gatos 2, Cal.

Letters

Dear Wayne,

Nice going so far. As more time goes by, it would seem more unlikely that the FCC will take any action on RM-499. Goodness knows I wouldn't want the job of all that retesting, and the policing of it would be a nightmare.

Your idea of putting the IoAR into the business of showing other nations how a strong amateur service is in their own national interest is the best yet. It is the first idea I have seen that is likely to do a great deal of good in preserving our bands. (the same thing goes for showing our government too.)

With all of this going on it is understandable why you have not gotten involved in too many other matters what with running a magazine and all. However, there is one item which might do a lot of good if it hit the pages of 73 before the next meeting of the ARRL's Board of Directors. This is the matter of By-Law 8.

You already have a copy of the letter which I wrote to all the Directors on the subject, so I won't go through all that again. It is easy enough to show that it is illegal under the League's own Articles of Association, etc.

One thing which I would like to point out is that By-Law 8 has a definite relationship to the RM-499 mess. The line of reasoning goes like this: By-Law 8 is an outgrowth of the League's opinion of the Conditional and Technician class license holders. It considers them to be lower of life—unfit to hold office in the League. Now RM-499 wants to make the General Class a lower form of life. How long would we be considered fit to hold office if RM-499 were to pass? Remember, the Generals would have far fewer operating privileges than the present Conditionals.

Consider too that a large percentage of the nation's amateurs are Conditionals and that they are found in areas away from heavy population centers. This means that those elected to be Directors tend to come from the denser population areas. This may not be good. It is certainly unfair to a General such as myself who knows and respects several Conditionals and would like to nominate one of them for director.

I could run this on and on, Wayne, but I'll cut it off here. I just wanted to remind you of this. I hope that you will see fit to give it a push in the right direction.

James S. Hunt K5ZXL

Dear Wayne,

Thank you for your reply to my letter of inquiry concerning the purpose of your opinion poll. I must explain, however, that I had never read any of your editorials. I had never seen **73 Magazine** but was asked to vote by ARRL supporters. In brief, I have been sheltered in the pages of **QST** and was quite unaware of the existence of I O A R .

Your taknig the time to answer my letter as you did was so appreciated that I sought out and borrowed the past six issues of 73 and digested the contents of your editorials and other pertinent articles. I think you have

real genius in the editorial field. You're a prolific idea generator and you have the power of expression to communciate them effectively. I would be pleased to be acquainted with you.

I shall get to know you better as I read your editorials in the future, for I am enclosing my check for a year's subscription to **73 magazine.**

This is not to say that I agree with all of your ideas on the incentive licensing issue, but you certainly have enlarged my field of vision on the subject. On the critical side, I feel that you occasionally become carried away with the spirit of opposition and have a tendency to be a little too vindictive. I also note that you occasionally depart from your usual factual logic and resort to innuendo or defend something which is not entirely consistent with your previous line of thinking. The risk here is the suggestion to your readers that your editorial genius may be subordinating to mercenary considerations. I sincerely hope that this is not or will not be true either consciously or subconsciously even though it is clearly evident that you could stand to profit handsomely from the major split in the amateur ranks.

I think your criticisms directed toward the League are a good thing. I have felt that a number of reforms were in order for a long time but was unaware of many of its shortcomings which your magazine has pointed out, and which information I was not likely to obtain from **QST.** In your criticisms of ARRL, however, I ask that you try to be charitable and constructive at all times and consider that a careless innuendo or the mention of an unfounded rumor, other than to discredit it, may sow seeds of hatred among the ranks. I know from your editorials that you do not seek to destroy the League but to institute reforms, but again I caution that hastily phrased thoughts put in print may be destructive.

It is quite likely that the F.C.C. will reject RM 499 and the foes of ARRL will rejoice in its defeat, overlooking the actual service which it performed by forcing the issue. All of the editorials that the ham magazines could ever publish could not have awakened the ham population from their complacency like that single controversial act of submitting RM 499! You tell me that you have been fighting the status quo for twelve years but what have you accomplished that can compare to the awakening produced by RM 499? So maybe you shouldn't be too hard on the League officers for this because it may be just what we needed—a good luck!

On one hand, I think that the ARRL needs a man like you in its administration, but on the other hand, I'm glad you're outside because it needs a good critic even more, so more power to you. But please, for the sake of T.O.M., be charitable—remember they're amateurs, hi.

Since the back issues of **73** that I now have are borrowed, I wonder if I might be able to purchase from you the last six issues (Oct. '63 thru Mar. '64)? And don't forget to enter my subscription promptly——I wouldn't miss your editorials for the world from now on.

Paul R. Noye K2KAM
Tonawanda, N. Y.

Back issues are on hand (50c each). Is it OK if I am charitable to the amateurs and hard on the professionals? You're right about 499 . . . three cheers. I try to be constructive, but a times my patience is too sorely tried . . . I'm fallible. Regarding unfounded rumors, please remember that these basic tools for any writer who wants to influence events without suffering law suits.

Dearborn, Michigan

There'll be an Old Timers Night at the Henry Ford Museum on May 30th put on by the Motor City Radio Club. W4FZ will be the main speaker of the evening. Special certificates are available to anyone working W8MRM starting on the 29th. They'll be on all bands.

Vladimir Gercke K6BIJ
Box 143
Weimar, Cal.

TVI

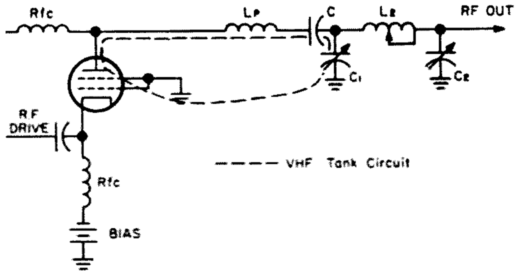
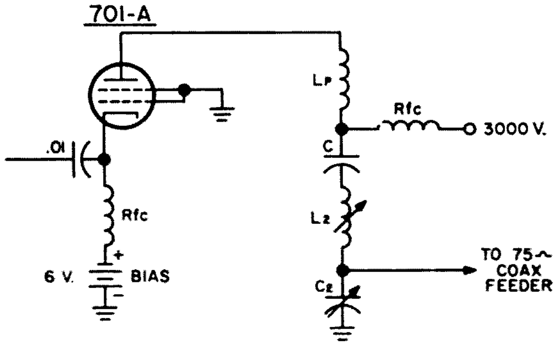


FIGURE 1



C -.01 Mica 6000 V.
C2-3 Gang B.C. Condenser, about 1000 pf.
FOR 80 METERS
Lp and L2-Antenna coils from 4-5.3 Mc. ARC-5 transmitter.

FIGURE 2

The Handbook and most of the magazine articles on TVI seem to advocate a shielding principle of TVI suppression, in other words—let TVI run wild inside the transmitter enclosure, but do not let it out. This is accomplished by an airtight transmitter cabinet, feed-through condensers, shielded and bypassed cables, rf chokes, cans over meters, and finally a low-pass filter to let the fundamental out.

The following experimental circuit approaches the problem from another side—it does not *generate* any TVI, so that you have nothing to suppress, and therefore you will not need any of the above precautions.

Let us take a very popular grounded grid kw final with a pi-network output (Fig. 1).

The tube elements, Lp, CI and the leads between them, form a tuned circuit resonant close to TV frequencies. This circuit can either amplify TVI or produce it. Lp—is a very mysterious component, every final has one; its size, diameter, and the number of turns (as well as explanations as to its purpose)—varies with the weather, author's diet and position of the planets. Generally it has about 5 turns ¼" i.d. and is supposed to do something. People that like the smell of burning carbon resistors put about 100 ohms across it.

A much larger coil in place of Lp will make either oscillations or amplification at TV frequencies impossible because the tube plate will be isolated by this coil (acting like an rf choke) from its VHF tank. A still larger coil will make it impossible to amplify the fundamental, as it will isolate the tube from its fundamental tank.

Now, if we make Lp about double the size of L2, we will find that the circuit still works at the fundamental, but any generation or amplification of TVI frequencies is no longer possible.

Further examination of the circuit shows that CI is not necessary, and RFC can be moved to the cold end of Lp (to remove most of the rf voltage from it). This way we arrive at the circuit Fig. 2.

Any radio engineer will tell you that this circuit cannot possibly work, but the circuit does not know it, and is pushing rf into the antenna as a grounded grid linear with normal efficiency and not a trace of TVI, while the engineers stay off the air when their wives are watching television.

The circuit in Fig. 2 is strictly experimental (it is a form of a series resonant tank); it was used on 80 and 40 with a single 701-A or a

pair of paralleled 715-B's with 3000v on plates nd a legal limit input. All values are not ptimum, but seem to be a good starting oint to experiment for your particular rig.

. . . K6BIJ

The Institute

The ONLY organization actively working to preserve amateur radio is the Institute of Amateur Radio which is actively lobbying for our hobby. Your help is needed desperately. Membership is $10 per year. Is ham radio worth **that** to you?

Novice Transmitter

Robert Stessel K1WXY
130 Columbia Street
Peace Dale, Rhode Island

In my town of modest ham population, I have seen several mobile phone transmitters sitting, just gathering dust. There are probably quite a few more around the country. These transmitters, usually xtal controlled and with inputs under 75 watts would make dandy first transmitters for Novices if they were converted to fixed, CW operation.

Three things must be done to mobile transmitters to make them suitable for Novice use. (1) Provide for CW operation; (2) provide B and filament power; and (3) provide for antenna changeover from receive to transmit.

To convert the transmitter to CW, find a convenient spot on the chassis for an open circuit key jack and mount it. Then break the connection from the final amplifier to ground and then connect the cathode to the jack and bypass the cathode to ground with a .001uf 1000 volt disc capacitor. (See Fig. 1) Next mount a 3Pdt switch on the chassis (on the front panel if there is room) and connect it as in Fig. 2. The switch shorts the key jack in the AM position so that the transmitter may be used when the General ticket arrives. On CW, it turns off the B to the modulator and shorts the modulation transformer to prevent unwanted keying transients.

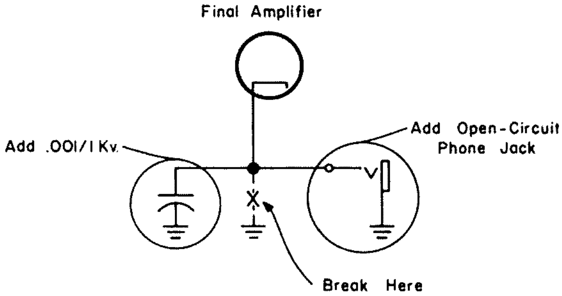


FIGURE 1

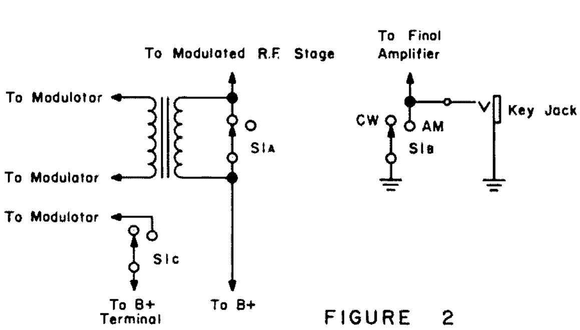


FIGURE 2

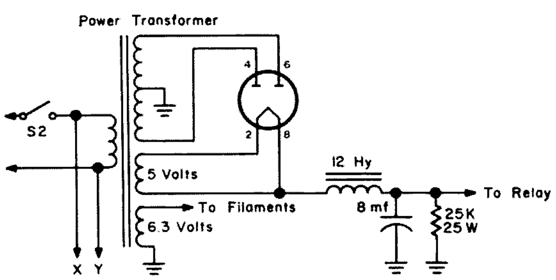


FIGURE 3

A schematic for a power supply is shown in Fig. 3. The power transformer should have a high voltage secondary voltage of twice the dc output voltage required. The filter choke and the transformer secondary should be rated at about 150% of the total dc current drain. The filter capacitors should be rated at 150% of the dc output voltage. If the transmitter requires 12 volts on the filaments instead of 6 volts, a 6 volt filament transformer will have to be connected in series with the 6 volt winding on the plate transformer. (See Fig. 4).

To operate the changeover relay, a power supply delivering low voltage dc could be built, but this experiment failed miserably at KN1WXY. Adhering to the old phrase: "If at first you don't succeed, to heck with it!" I replaced the dc relay with one that operated on 110 volts ac and wired it as in Fig. 5. If you want to keep the dc relay for possible mobile work in the future, mont the ac relay inside a small minibox and bolt the box to the transmitter somewhere near the rf output cirquitry. Then mount a feed-through insulator on the box so that one end of it is in the mini-box and one end in the transmitter and wire it in. The terminals on the relay marked receiver can be used to short the speaker in transmit using the normally open terminals or to open the receiver power transformer secondary during transmit by using the nomally closed terminals. If full break-in operation is desired, connect the

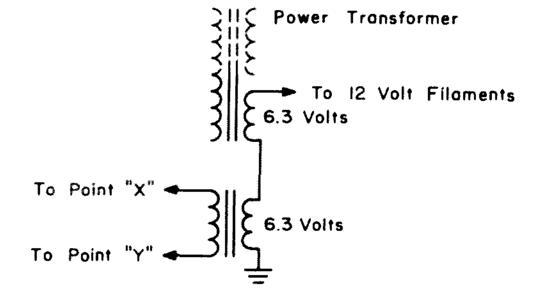


FIGURE 4

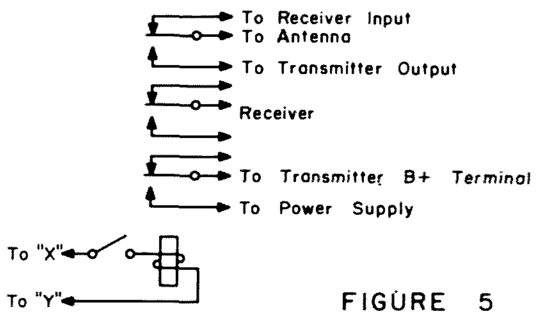
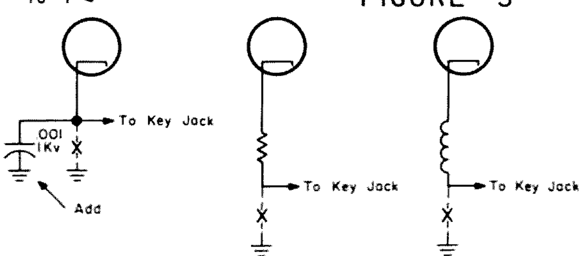


FIGURE 5



CATHODE AT R.F. GROUND CATHODE ABOVE R.F. GROUND

FIGURE 6

athodes of the oscillator and any driver or nultiplier tubes to the keying jack and disconıect its connection to ground. If the cathode is t rf ground, bypass it as in the final; if it is bove rf ground (if it has an rf choke between : and ground) connect it to the keying jack t the point at which it is grounded and break :s connection to ground (See Fig. 6). Disconect the receiver from the relay and leave the ·ansmit-receive switch in transmit all the time. Vith break-in, a separate receiving antenna ıust be used, preferably at an angle to the ·ansmitting antenna. If this is inconvenient, an lectronic TR switch could be used. A good cirıit was shown in the May '63 issue of 73.

This completes the modifications. Because of ıe wide variety of mobile transmitters floating round, no operating instructions will be given ere. Tuning-up will be the same as with AM,) ask the previous owner how to tune your new Novice transmitter.

Much thanks to W1BXZ, K1IDX, and W1QLT for the help in getting me started in hamming and homebrewing. . . . K1WXY

(An anthrozological study based on five years of research by the author, who carried out her investigations at gatherings of the genus throughout Britain and Europe, particularly at the Radio Communications Exhibit in London.)

H. S. T.

Sylvia Margolis
XYL-G3NMR

HOMO SAPIENS TRANSMITTENS is a warm-blooded vertebrate, despite several indications that both these initial premises are without foundation. It is a specialized mutation of HOMO SAPIENS NORMALS, developed within the first half of the twentieth century, and likely to continue evolving into the Space Age, unless more and more emerging nations are going to demand frequencies for broadcasting their national propaganda, in which case the genus might become extinct —*viz. "Dinosaurs I Have Known" (Fred Flintstone)* and *"Dodo Where Art Thou?" (Terry Dactil.)*

While HOMO SAPIENS NORMALS and HOMO SAPIENS TRANSMITTEN evolved originally from the same species, the two geni are rapidly drawing apart. There is now little resemblance between them and some authorities admit to their inability to recognize any of the behaviour patterns of H.S.N. in the more highly modified specimens of H.S.T. In any ritual gathering of H.S.N., a well-developed H.S.T. will stand out like a *thumbus sorus,* distinguished by his appearance of wishing he could get the hell out of here.

Distribution—The genus is to be found in every Continent, but with the greatest density in areas with high living standards. It is a boast of the genus that it knows no barriers of race, belief or background. In this respect we recommend students to refer to *"Hamlet,"* Act 3, Scene 1, lines 8 and 9 of the "To be or not to be" speech.

It is interesting to note that H.S.T. develops the transmittens faculty superimposed onto his national or ethnic characteristics, but that the transmittens faculty eventually over-rides the normal behaviour patterns, producing a truly international H.S.T. who hardly differs from other H.S.T.'s, whether he be from Singapore or Oslo, Durban or Montreal. He has developed a complicated classification system himself to differentiate between national groups, but could easily carry on the transmittens operation without this, whereon nobody could be any the wiser. It is almost impossible to distinguish between the various nationalities on the tribal occasions when they all congregate, such as I.A.R.U. Conferences, the New York Sideband Dinner or the London Radio Communications Exhibition.

Most of the genus are male (more or less) although there has developed a small proportion of H.S.T. with female characteristics. These are the exceptions which prove the rule.

When there is a very great density of H.S.T. in one location there occurs an interesting phenomenon known as "QRM" (*Quod res miserabilia.*) This causes great distress to all specimens who then devote great energy trying to persuade each other to move house or to try 70 cm. working.

Habitat—A noticeable disregard for the basic comforts and for the condition of the habitat is a distinguishing feature of H.S.T. The living room may need decorating, the closet door hanging from one screw, the plumbing may be making sinister noises and showing alarming symptoms, whilst there may be wiggly cracks in the foundations. However, H.S.T. is more closely concerned with the state of the beam and with protecting his V.F.O. from damp. Those few H.S.T.'s who live long enough, and who have enough dough, to build the ideal house for retirement, employ weak-willed architects who agree to design, first a central tower, then arrange round it grudgingly a few inessential items, like kitchen, bathroom, bedroom.

H.S.T. thrives in an atmosphere of litter, scattering components and instruments round the habitat and dropping blobs of solder on the rugs. He tends to decorate the habitat with objects known as "QSL's" (*quod sillius laboro-wastus.*)

There is a noticeable trend to living on high ground, where the height is advantageous to he transmittens faculty. He will also seek isolated habitats, because of a condition which enders him very offensive to H.S.N. This is nown as *te livis ion inter ference.* Extreme cases of this condition have been known to cause physical struggles between the two geni and there have been occasions where .S.N., normally a peaceable creature, has banded together with his fellows and destroyed ie transmittens faculty of an offending H.S.T. This is a lamentable situation.

Language—As the genus rarely speaks socially, except to another of the genus, anguage differences present few difficulties. A signal crystal frequency synthesizer or a undamental flip-flop circuit are much the same, whether in English, Serbo-Croat or Urdu. One of the most striking features of the angauage of H.S.T. is *how much of it there is.* This is demonstrated every night on twenty netres sideband. H.S.T. can take longer to say goodnight than any boy on his girl's porch.

When H.S.T. first began to evolve from H.S.N. he did so in the form of a primitive creature known as a "CW Type." The CW Type was unable, because of technical dif-iculties, to converse in conventional language, o used a system of long and short squeaks (*lingua samuelis morsi.*) During the past thirty years this form of communication has been uperseded by something more resembling iormal language, although large numbers of he genus prefer to use CW and insist that it s a form of communication superior to ordinary peech. It is interesting to note that present-lay H.S.T. still reverts to this atavistic practice ind his language bears witness to the old orms. He will, for example, call his wife iis XYL," painstakingly explaining that this neans "ex-young-lady," despite her protests hat she is neither ex-young nor ex-lady. A rimitive way of expressing mirth, similar to he *rictus* of *Pithecoidea,* is "Hi."

Anatomy—To the greater extent the creature esembles H.S.N. physically. There have, how-ver, developed specialized physical features, uch as the mike-bend, carrier-eliminating arynx, built-in wife-and-child-filters and ex-eptionally modified Eustachian tubes, in the ase of HOMO SAPIENS S.S.B. TRANSMIT-'ENS, which are only capable of reading

signals up to 2½ kcs. wide.

Physiology—H.S.T. possesses, as far as can be ascertained, the same basic functioning patterns as H. S. N., although, again, some of these have undergone considerable modification during the evolutionary period in order to fulfill efficiently the transmittens function. H. S. T. is capable of immense feats of physical endurance, whereby he can stay awake for fully forty-eight hours, during the Sideband Contest or National Field Day, whereas fatigue overtakes him the moment he has to associate with H.S.N.

Food—It is customary for the genus to leave its food for long periods after serving before eating it. Thus he shows a preference for cold, congealed, toughtened, soggy and altogeather revolting food. In this respect the genus can be compared with *crocodilus porousus*, which keeps its kill in secret hidey-holes under the water, not eating it until it is partially decomposd.

Drink—H.S.T. does a lot of this. Indeed his marked predelication for beer could well be the basis of serious experiments to see whether the genus could be entirely nourished on a diet of alcohol. There is even a belief that large quantities of alcohol improve the signal. Experiments in this field are enthusiastically carried out any New Year's Eve on seventy-five meters.

Reproduction—It is possibly in this field that H.S.T. differs most markedly from H.S.N. There is a remarkable tendency to ignore, or at least to hold in the deepest suspicion, females. This accounts perhaps for the extremely high percentage of bachelor H.S.T.'s. Of the small proportion of female H. S. T.'s encountered during my investigations, I would only quote the old saying about the female of the species.

It is on close examination something of a miracle that H.S.T. manages to reproduce itself at all, considering that at the crucial moment, he is likely to remember how precisely to couple the output from the plate circuit of the harmonic amplifier into the receiver. The usual taradiddle attached to the relations between the sexes in H.S.N. is given scant emphasis in the courtship procedures of H.S.T., to whom the whole darn thing is of no interest whatever.

Thus H.S.T. ignores the conventional stress on phallic symbols of modern H.S.N.—sharp dress, snazzy automobile etc. Instead he sublimates his biological urges by competing in CONTESTS. With Contest goes certificate hunting. To enlarge on this theory, we sugges

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that the serious student of anthropology watch a barnyard rooster putting on the style in front of another rooster. Then the student should give the same attention to H.S.T. displaying his collection of diplomas and rare QSL's to another H.S.T. who has a shorter antenna. Some experts put forward the theory that the interest shown in the reproductive conventions is in inverse proportion to H.S.T.'s DX score.

To give a convincing example, whereas H.S.N. would entice a girl up to his apartment to show her his Japanese prints, H.S.T. will invite her to examine his linear and exciter. And show her his linear and exciter is exactly what H.S.T. will do.

Evolution—That H.S.T. will evolve and alter his functioning continually is a surety. Already one sub-genus of the genus has become almost obsolete—the "A.M." operator. Isolated pockets of these specimens still exist but they are rapidly dying out. An important sub-genus—the "VHF Type"—is developing on its own lines and may at some time present another genus as different from the specimens of H.S.T. discussed here as H.S.T. differs from H.S.N.

Conclusions—The study of HOMO SAPIENS TRANSMITTENS presents a most rewarding field for the serious student. The author has attempted here to give only a basic survey but would welcome enquires, data and further information from any readers who are interested in investigating this most intriguing of Nature's mistakes.

Hobbyist? Write about it

Gordon Hopper W1MEG

Industries related to electronics, aviation, chemistry, automotive, and photography are often found to contain a nucleus of people who carry their technical abilities into various hobby fields. Included as part of this nucleus are various publications people such as writers, illustrators, parts listers, etc. It is to these technical writer/hobbyists that this article is directed with the intention of encouraging writers to write more technical articles for the hobby type of publication.

My own personal interest in the hobby

field applies to amateur radio. There is a noticeable shortage of articles available today relative to the subjects of parametric amplifiers, pulse transmissions and techniques, laser and maser design, construction, and their advantageous uses, plus some of the more advanced forms of communications such as teletype, television, multiplex systems, and facsimile. In addition, commercial manufacturers offer opportunities for a writer to conduct tests on various types of equipment to result in a written report of its capabilities, qualities, features, specs, operation, etc. to be published in the hobby magazine.

In the numerous technical publications that are on the market today, there is always a need for better written technical articles. Currently, these articles are generally written by people not engaged in the writing profession and, consequently, this puts a heavy workload on a magazine editor if he deems the article worth buying.

Technical writers already having qualifications such as writing to government specifications, a technical background, the ability to read and interpret complicated schematic and mechanical diagrams and drawings, plus the competence of incorporating engineering data into technical manuals and various publications, are ideally suited to write technical magazine articles in their spare time.

If these writer/hobbyists were to write technical articles for magazines on a level commensurate with its readers, the quality of the articles could be noticeably improved, thus raising the standards of the publication itself. Magazine editors are busy people and most of them will accept articles that are well written and which require little or no editing much more readily than they will accept an article which needs changing, correcting, or rewriting. Most magazine articles are written to a general set of rules (format, illustrations, length, etc). Magazine editors will furnish you, upon request, with their specifications and rates of payment for accepted work.

Let me recommend that you investigate the technical hobby magazine writing field and then submit articles to these magazine editors. Hopefully, the quality and standards of these magazines would be raised, readers' knowledge would be increased, you would be paid for your work, and you would achieve some measure of prestige. Incidentally, there is no better way of stirring up interest in your pet theory and of meeting people with similar interests.

Try it.

. . . WIMEC

(W2NSD from page 4)

who went on record were opposed to 499. Strange that this figure should be the same as the result of our ballot, eh? They found that the single petition that had the greatest support was the one filed by W4RLS, Foy Guin. Fifteen amateurs went to the trouble to submit petitions . . . and only one was in favor of the ARRL . . . the one by Bill Orr W6SAI. 14 to 1 against the ARRL . . . hmmm. The directors might want to question Mr. Hoover about that.

They might also ask him what he thinks might happen if the FCC were to pass 499 into law and another earthquake were to hit Alaska. Out of some 800 amateurs up there who can use 20 meters, only 150 are Advanced Class. Communications were difficult enough during the recent difficulty with the few Alaskan ham stations . . . imagine if only one fifth of them had been able to use twenty meters! As I pointed out in previous editorials, we have few enough amateur stations right now when it comes to providing emergency communications.

Institute of Amateur Radio

The first board of directors meeting of the Institute was held in New York on March 23rd with four of the seven interim directors present. Present were Bill Ashby K2TKN, Wells Chapin W2DUD, Lloyd Haslam W3AYA, Harry Longerich W2GQY/4, plus Virginia and me. Absent were Bill Leonard W2SKE, Edwin Schaad WA4PDX, Maurice Hinden W6EUV.

(Turn to page 86)

Correction

April 1964 issue

The IN540'S in the Mon-Key circuit are reversed

We Dare

We are quite certain that 73 is the only ham magazine that is growing in circulation, month after month, and we challenge any other magazine to match post office receipts with us.

A financial report was made. The membership dues for 1963 had been more than offset by the loss on the Institute tour, leaving the slate fresh for 1964. As of March 21st we had 328 Founding Members ($10) for $3280 income. Expenses for certificates, membership cards, newsletter and clipping service had been $265, leaving a net cash on hand of $3015.

The Newsletter was reported to be almost ready to begin publication. Special paper had been selected and purchased for it, a newspaper clipping service had been engaged and more than enough information was coming in to publish a newsletter weekly on the public service aspects of amateur radio. The mailing list of Congressmen and government officials was being made up.

The Directors agreed to relieve me of the responsibility for actually guiding the Institute, though I promised that I would do everything that I could to carry out their decisions and to help the Institute grow. I offered to make at least two pages a month in 73 available for the dissemination of news of the Institute at no charge for at least five years.

A discussion of the need for a constitution and by-laws brought complete agreement that this was one of the most important immediate tasks for the directors. Considerable help is expected for their formulation by the two directors who are also lawyers. The result of the directors thinking will be sent to the members for their comments.

There was general agreement among the directors that we should expect a strong attack by the ARRL through the pages of QST, through CQ, at conventions, and just about everywhere else. The growth of the Institute can be expected to be as popular with the ARRL as the growth of a reform movement is to an intrenched political machine.

The Directors

Undoubtedly you know some of the directors of the Institute. I'll try to have short biographies and a picture for you by next month. I'm very proud of the fellows who have agreed to help get the Institute started on the right foot. You must know Bill Leonard W2SKE of the Voice of America ham program, of CBS TV, inveterate contester, and hamfest toastmaster. Wells Chapin W2DUD should be familiar to you if for no other reason than his recent articles in 73. He has a marvelous background. Ed Schaad WA4PDX was Chief of Army MARS 1958-60 and retired as Lt. Col. in 1962. Harry Longerich W2GQY/4, also recently retired from the Army, was Commanding Officer of the European Intelligence Division. Maurice Hinden W6EUV is a very well known West Coast attorney who has helped many hams out of ham legal difficulties. I ran an interesting series by Maurice in CQ a few years back. You all must be familiar with Bill Ashby K2TKN (ex W9ETJ) . . . he has the feature article this month . . . a break-through development.

I don't know if there is any way to make sure that we continue to have directors of exceptional intelligence and dedication; I sure hope we find a way.

To ARRL Directors

In a few days you will all be getting together for one of your yearly Board meetings. Fellows, we are all going to be watching the fine print in QST very carefully to see how seriously you take your jobs.

We'll be watching for yes-men and unanimous decisions.

I'll be listening for reports to see if you let those rascals get you together for a secret meeting before the regular meeting to cook up schemes which won't appear in the official minutes. Don't try any of that "committee of the whole" on us either, we want to know what you are doing for a change.

Give some serious consideration to splitting up QST and ARRL to some degree. It is not possible for one man to do a good job of running both. You'll get a lot more output from two $12,500 men than from one $25,000 man.

Why not take some of that fantastic profit from the sale of the old headquarters building and put it into a Washington headquarters? Or perhaps dip into some of that stock you've put away (worth over a half million now, isn't it?). You've got lots of money and you'll never find a better place to spend it.

If you get a sort of helpless feeling and find that you're being voted down at every turn, don't worry about it. Even if you find that you don't somehow seem to have the power to run the League that you and the State of Connecticut thought you had, you can relax a bit for you know that there is always going to be the Insitute of Amateur Radio to pull your fat out of the fire. The Insitute has already started a regular mailing of an information newsletter to nearly one thousand congressmen and government officials with the object of making better known the public service of amateur radio and its benefits to our country. The Institute has an official representative in Washington and is planning on having its headquarters there. So don't fret if there is more money and attention being lavished on the ARRL big yearly free booze party at the Parts Show in Chicago than on lobbying for our hobby.

Don't get frustrated when you try to find out what good the IARU is going to do for us. Don't let vague platitudes upset you when you ask what is being done to approach the people who will be gathering at Geneva next year (in 1965) for the plenipotentiary ITU conference in order to get ham radio a better shake. Oh, look up "plenipotentiary" in your dictionary and bring the definition to Hunty . . . a recent panic mailing by him (published in CQ) gave evidence that he either doesn't

73 Products and Publications

6UP Magazine. The only fullfledged monthly devoted to VHF. Invaluable to the Technician and the VHF/UHF DX'er and experimenter. Activity reports on all band openings. Wide band FM news. Six meter news. Two meter news . . . 220, 432, 1296 . . . etc. Construction articles, antennas, etc. K5JKX editor. **$2 per year.** Don't miss a single copy of this interesting magazine.

ATV Bulletin. The Amateur Television Experimenter is the only publication devoted to ham-TV. Circuits, operating news, conversions of surplus gear, ads for TV gear, discussions. WØKYQ editor. **$2 per** year, published bimonthly.

Back Issues of 73. All back issues of 73 are available for **50c each** except June 1962 and January 1961, which are unavailable, and Oct-Nov-Dec 1960 issues, which are $1 each. We'll *pay* $1 for a January 1961 or swap for it.

Binders. Bright red leather gold stamped with 73 and year. Specify 1960-1, 1962, 1963, 1964. **$3.00 each.**

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WØKYQ editor. **$2 per** year, published bi-
Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

73 Inc

Peterborough, N. H.

know what it means or was trying to pull wool over eyes, or (I suspect) both.

Remember, as more ARRL members get fed up with words instead of action, that the Institute is going to be able to tackle the international situation on a more direct basis . . . sending out an international edition of the information newsletter . . . getting travelling amateurs to visit foreign officials and answer questions they may have . . . getting amateurs who are visiting foreign countries to set up locals with a club station provided by the Institute (a program we've already started) . . . etc.

Incentive Licensing

Some time ago, while looking over all of the petitions which had been filed with the FCC on the subject of incentive licensing, I became aware that none of them included all of the ideas which I had put forward in my editorials. In looking over the list of the factors of RM-499, I could see that my overall plan seemed to provide all of the good points of 499 without any of the drawbacks. It even had some additional benefits and solved some problems which 499 left begging.

My major objections to RM-499 are these: 1) since 499 will remove over 75% of the presently licensed amateurs from the major phone bands unless they pass a new exam and since we know that not all 100% of those affected will get the new license, we must admit that 499 will reduce the occupancy of our most important international phone bands. This, unfortunately, will happen at the worst time possible, just before a Geneva conference. 2) 499 offers no incentive for the CW operator. Is there some reason why a CW operator needs no encouragement to improve himself technically? This is plainly discriminatory. 3) 499's message to either get a new license of else get off the major phone bands is not incentive, it's compulsion. Many agree that compulsion is the enemy of freedom. 4) 499, as described by QST, cannot possibly achieve even the vague objectives mentioned by ARRL. A slightly more difficult test than the present one for General Class would only mean more memorization. What on earth does this gain us? 5) 499 is extremely unfair to the General Class licensees since they have already passed a test almost identical to the one passed many years ago by the Advanced Class operators. Yet the Advanced Class have mysteriously been exempted from re-examination. 6) 499 directly opposes not only the FCC's stated policies of not taking away privileges from any licensed operator, but opposes the established demo-

cratic system of the U. S. wherein privileges, once earned, are not summarily taken away.

There is no real reason why our proposed legislation has to have all of these serious drawbacks. It is quite possible to work out a plan which will achieve the stated goals, avoid the above difficulties and solve several long standing problems to boot.

What would we like a proposal to accomplish? Well, we want it to provide incentive to fellows to improve their technical knowledge. It should provide incentive for both phone and CW operators. It should not force anyone off any of the bands they are using at present or diminish the value of his equipment by rendering it useless to him. It should do something for the Extra Class license to give it some meaning. It should not impose any severe hardships on the FCC from the standpoint of divising license exams, adminstering license exams, or monitoring our bands. It might even do something about the almost completely unused lower 100 kc portion of six meters which the ARRL rammed through against all reason a few years back. It might recognize the advancement of sideband by establishing some SSB bands. It might also recognize the growing percentage of amateurs using phone by expanding our phone bands somewhat.

Proposed

I propose that two new classes of license be established; and Extra Phone and Extra CW. Holders of the present Amateur Extra Class license would automatically be issued both of these new licenses. Holders of Advanced, General and Conditional Class licenses could qualify for either or both of the new licenses after a minimum waiting period of one year in the present class of license by passing an FCC supervised license exam.

The Extra Phone license would be available to those passing the theory test given for the First Class Phone (commercial) license (let's see anyone memorize their way through *this* one) or those having in the past passed this exam. The Extra Phone licensees would have all operating privileges of all lower class licenses plus the use of suppressed carrier telephone in the following bands: 3750-3800 kc, 14150-14200 kc, 21.20-21.25 mc, 28.4-28.5 mc, 50.01-50.10 mc. (The Novices lose a little on 15 meters and note the sideband on six meters).

The Extra CW license would be available to those passing the theory and code test given for the First Class Telegraph (commercial) license, or having in the past passed this test.

Extra CW licensees would have all of the privileges of the lower classes of license plus the exclusive use of the following CW bands: 3500-3520 kc, 7000-7020 kc, 14000-14020 kc, 21000-21020 kc, 28000-28020 kc.

To permit quick identification of Extra Class licensees a distinctive call should be issued. This would simplify monitoring problems and provide additional incentive for the acquisition of this class license. I suggest the addition of an "E" after the first letter of the call as a distinguishing mark. "W" calls would then be "WE," "K" calls would be "KE" and "WA" calls could be "NE," with the remainder of the call unchanged. It would also be an additional incentive if a desired two-letter call could be requested upon paying the $20 special call fee. This would permit two thousand two letter calls in each call area.

K6BX

Directory Extra News Letter #17 just arrived. It has about the equivalent of 20 pages of 73 devoted to RM-499 and ARRL. Cliff has published many of the letters I have received giving inside dope on how bad things really are at League HQ. Unfortunately much of it is written in Cliff's own rotten style. See for yourself, if you want to know what's what. Send 50c to K6BX, Box 385, Bonita, California.

You Test It

One of the best tests of a new piece of equipment is how it works in the average ham shack. Lab tests of new gear frequently miss important operating points which turn up when the unit is used for a few days of normal operating.

If you're the kind of fellow who like to buy something when it is new to the market you might consider taking a little extra time after using it and writing up a users report for everyone and submitting it to 73. If you're first and have done a good job of evaluating the unit then you stand to get from $25 to $50 for the report . . . which might even help pay for it a little.

Updating the ARRL

Severe limitations are built into the ARRL Constitutions and By-Laws which have prevented many good men from being nominated for the position of Director. Under By-Law 8 a Conditional or Technician licensee cannot run for Director. This immediately eliminates over 100,000 licensed amateurs from holding this office. In some areas this makes the selection of a candidate extremely difficult since almost all amateurs are Conditional Class.

Article 12 of the ARRL Constitution is a holdover from the dim dark ages and has been a major obstacle to members wishing to nominate experienced hams to Directorship. This one says that no one shall be eligible for the office of Director, Vice Director or President who is commercially engaged in the manufacture, sale or rental of radio apparatus capable of being used in radio communication, or is commercially engaged in the publication of radio literature intended in whole or in part for consumption by radio amateurs.

The last part is OK . . . it makes sense for the leading amateur radio publishing house not to allow control of the company to fall into the hands of another publisher. But we have a number of manufacturers who sell to hams and distributors who sell to hams who would be invaluable to us as Directors of the ARRL. There is nothing like having your life's work in the industry to know intimately what is going on. Yet these fellows are not permitted to give us the benefit of their knowledge and experience. Directors, voted in by the amateurs in their sections, would undoubtedly bend over backward to keep from having any possible conflicts of interest. I believe that the end result would be far superior to the persent system. I've received reports of three serious cases of manufacturer influence, involving top officials. I see strong indications of at least one other. I don't think that these incidents could possibly have happened if anyone from the amateur industry had been on the Board of Directors.

Outstanding Amateur

The nominations for the Institute of Amateur Radio Outstanding Amateur Award are starting to come in now and we plan to have our first listing of these nominations in the June issue. Please send us a letter giving all the particulars you can on any amateur you know that you believe rates this award.

The first award went to Merrill Swan W6AEE for his pioneer work in amateur RTTY. Our second award goes to Don Chesser W4KVX for his untiring efforts to provide communications for those interested in the world of DX. Don has been devoting his entire life to the publication of his DX Bulletin ever since the first issue back in May 1957. Don is to a great degree responsible for the current high interest in DXing and DXpeditions. His bulletin, which comes out about 40 times a year, keeps operators interested in working DX up to date on current activities.

Few amateurs have worked as hard and long as Don in the interests of amateur radio.

. . . Wayne

Radio Bookshop

1—CARE AND FEEDING OF HAM CLUBS—K9AMD.—Carole did a thorough research job on over a hundred ham clubs to find out what aspects went to make them successful and what seemed to lead to their demise. This book tells all and will be invaluable to all club officers or anyone interested in forming a successful ham club. Hundreds of grateful letters have been received from clubs who have applied the ideas in this book. **$1.00**

2—SIMPLIFIED MATH FOR THE HAMSHACK—K8LFI.—This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of undestanding basic math our kids would have a lot less touble. **50c**

3—INDEX TO SURPLUS—W4WKM.—This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on the article and source. **$1.50**

4—HAM-TV—WØKYQ.—Covers the basics of ham-TV, complete with how to get on the air for under $50. Not the usual theory manual, but a how-to-do-it book. **$3.00**

6—SURPLUS TV SCHEMATICS.—You can save a lot of building time in TV if you take advantage of the real bargains in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. **$1.00**

7—AN/ARC-2 CONVERSION.—This transceiver sells in the surplus market for from $40 to $50 and is easily converted into a fine little ham transceiver. Covers 29 mc (160-80-75-40 meters). This booklet gives you the complete schematic and detailed conversion instructions. **$1.00**

8—AN/VRC-2 CONVERSION.—Completely different from the ARC-2. This book gives you complete instructions on converting the inexpensive VRC surplus gear into a six meter wide band FM transceiver. There are probably over a thousand stations now operating on 52.525 mc around the country. Join the crowd. Fun. **$1.00**

9—COILS—K8BYN.—Basic book which covers the theory and practical aspects of the many different types of coils found in ham work. Well illustrated. **50c**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

12—CW—W6SFM.—Anyone can learn the code. This book, by an expert, lays in a good foundation for later high speed CW ability. **50c**

3D MAP OF WORLD.—Maybe you've been eating your heart out for one of these beautiful relief maps after seeing one at a friend's shack. Comes complete with one year subscription or extension to 73. **$9.95**

3D MAP OF U.S.—Complete with one year sub to 73. **$9.95**

13—REFERENCE DATA FOR RADIO ENCINEERS. Tables, formulas, graphs. You will find this reference book on the desk of almost every electronic engineer in the country. Published by International Telephone and Telegraph. **$6.00**

14—MICKEY MIKER—WØOPA.—Complete instructions for building a simple precision capacity tester. Illustrated. **50c**

15—FREQUENCY MEASURING—WØHKF—Ever want to set yourself up to measure frequency right down to the gnat's eyebrow? An expert lets you in on all of the secrets. Join Bob high up on the list of Frequency Measuring Test winners. **$1.00**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

32—RCA RADIOTRON DESICNERS HANDBOOK—1500 pages of design notes on every possible type of circuit. Fabulous. Every design engineer needs this one. **$7.50**

63—CE TRANSISTOR MANUAL—6th edition. This is one of the best buys around: 22 chapters, 440 pages, diagrams by the grass, data, facts, charts, etc. If you don't have this one you just aren't up to date. only **$2.00**

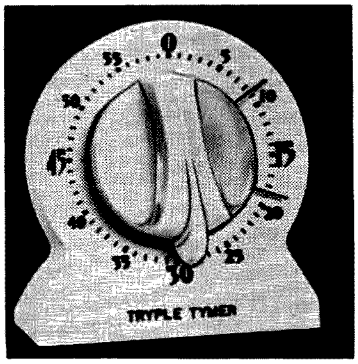
SPECIAL SPECIAL SPECIAL

Radio Handbook, 15th Edition, written by Bill Orr W6SAI, over 800 pages. Covers every phase of amateur radio from the very basics right up through the construction of just about everything you could want in ham gear. Originally published at $8.50. Superceded by the new 16th edition which is the same except for new construction projects and selling for $9.50 (see number 11). Special, until the last few copies are gone, only **$5.95!**

104—SCIENCE HOBBIES—Eleven American made semiconductors with instructions for making an automotive tachometer, a photocell light meter, a transistor preamplifier, an audio oscillator, a transistor regulated power supply, speech clipping, cathode biasing and screen biasing circuits. A $29.95 value **$2.98**

107—THE AMATEUR RADIO HANDBOOK—Published by RSGB. This is a thorough and complete 540 pages handbook which covers every aspect of amateur radio: tubes, transistors, receivers, transmitters, VHF gear, sideband, FM, antennas, mobile gear, noise, power supplies, and much, much more. You'll find this one suite interesting and informative. **$5.50**

108—RADIO DATA REFERENCE BOOK—Published by RSGB. This contains all of the formulas that you have to hunt around for when you want them, all in one place and indexed. There are such items as feedline charts, coax tables, yagi measurements, pi-net charts, wire tables, conversion factors, logs, thread sizes, reactance charts, filter design charts, etc. **$2.25**



116—TRIPLE TIMER. Works like regular kitchen timer except dings at three separate times. Fine for 10 minute reminders. Set once and it will ding every ten minutes for 30 minutes. Many other uses. Can be set to ring at any time intervals up to full hour. **$4.95**

109—AMATEUR RADIO TOWER INSTALLATION INFORMATION—published by Rohn. Nearly 100 pages of info on selecting, buying and setting up towers for amateur radio. While this book is one of the most complete catalogs of Rohn towers ever published, it also has all the instructions you could possibly want on installing your tower. Lots of good color pictures Well worthwhile. **$1.2**

112—COMMUNICATIONS RECEIVERS—Design considerations and a practical design for radio amateurs. Nicel written 32 page book discusses variou stages and presents a fine receive design for home building using regula commercially available parts. **75**

113—TRANSISTOR RADIO HANDBOOI—Simplified theory and many han construction projects, including SS exciters, SSB transceiver, VHF xmtr and rcvrs, etc. **$5.0**

114—RSGB BULLETIN—One year sub scription to the most popular amateu radio magazine in England. Top notch **$5.0**

Send check or M.O. to Radio Bookshop Peterborough New Ham Shire

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7•	14	14	14	14	14
ARGENTINA	14	14	14	7•	7	7	14	14	14	14•	21	21
AUSTRALIA	14	14	14	7	7	7	7•	7	7	7	14	14
CANAL ZONE	14•	14	14	7	7	7	14	14	14	14	14•	21
ENGLAND	7•	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7•	7	7	7	7	7•	14	14	14	14	14	14
JAPAN	14	14	7	7	7	7	7•	7•	7	7	14	14
MEXICO	14•	14	14	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	7	7•	7•	14	14	14	14
PUERTO RICO	14	7•	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7	14	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	14	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Good: 1-3, 10-11, 15-18, 22-25

Fair: 7-9, 12-14, 20-21, 26-31

Poor: 4-6, 19

Es: 6-9, 13-15, 21-24

(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7•	7	7	7	7•	14	14	14	14
ARGENTINA	14•	14	14	7	7	7	14	14	14	14	21	21
AUSTRALIA	14•	14•	14	14	7	7	7	7	7	7	14	14
CANAL ZONE	21	14	14	7•	7	7	14	14	14	14	14•	21
ENGLAND	14	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	7	7	7	7	14	14	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7•	7	7	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	7•	7	7	7	7•	14	14	14	14
PUERTO RICO	14•	14	14	7•	7	7	14	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7	7	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	7•

J. H. Nelson

WESTERN UNITED STATES TO:

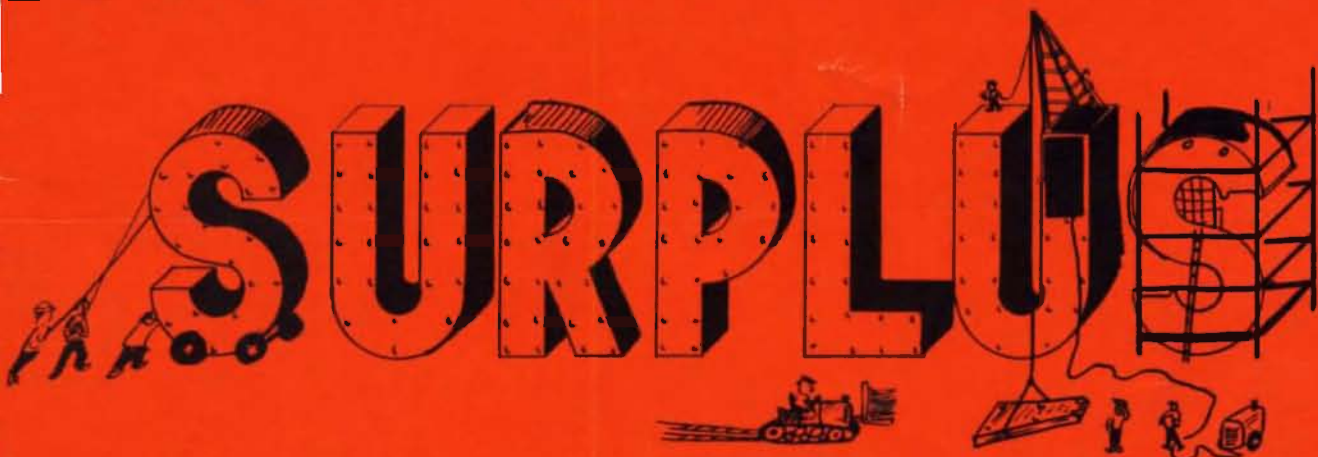
GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7•	7	7	7	7	7•	14	14	14
ARGENTINA	14•	14	14	7•	7	7	7	14	14	14	14•	21
AUSTRALIA	14•	21	14•	14	14	7•	7	7	7	7	14	14
CANAL ZONE	14	14	14	7•	7	7	7•	14	14	14	14	14
ENGLAND	7•	7	7	7	7	7	7•	14	14	14	14	14
HAWAII	14	14•	14	14	7•	7	7	7	14	14	14	14
INDIA	14	14	14	14	7	7	7	7•	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7	7	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7	7	7	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	7•	14	14	14	14	14
SOUTH AFRICA	14	7	7	7	7	7	7	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	14	14	14	14	7•
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

*** Means next higher frequency may be useful.**

73 Amateur Radio

JUNE 1964
About 40c

SECOND ANNUAL



CATALOG ISSUE

73

Magazine

Wayne Green W2NSD/1
Editor, etcetera

June, 1964

Vol. XX, No. 1

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de W2NSD/1

never say die

The past few weeks have been eventful for amateur radio. The Institute started mailing its weekly newsletters to every U. S. Senator, U. S. Representative, Governor and government official involved with radio. This has met with an enthusiastic response.

First reports of the ARRL board of directors meeting indicate that it went off remarkably smoothly, considering the serious problems facing them from RM-499, dropping membership, the Coca-Cola scandal, and the disintegration of IARU Region 2. We'll all be watching for the minutes of the meeting in the July QST.

CQ devoted an editorial to me, for which I thank them. A couple letters from IoAR members cover this pretty well . . . see page 62.

The Dayton Hamvention went off smoothly in its new quarters. For the first time since I can remember people weren't jammed like the New York subways trying to get from one exhibitor to another. I've been pretty hard on the ARRL HQ for RM-499 and other things of late and I sort of expected to be taken to task by fellows that hadn't bothered to find out what was really happening. All I got was hundreds and hundreds of compliments for having the courage to bring points of dispute out in the open.

W3NL published a letter that I had sent to all ARRL directors well before the board meeting. I hadn't published this myself for I didn't want to have them think that I was making a grandstand play. The gist of the letter was that all of us will be watching the minutes of this years meeting to see which directors have shown initiative. I explained that I intended to use 73 this Fall to bring more light into the election of directors than they have ever seen before. I want to encourage intelligent dedicated amateurs to run for director and I am willing to devote space in 73 to their qualifications and their platforms. I also mentioned that I knew a simple way for the League to increase its yearly income by from $250,000 to $500,000. Only one director, Phil Spencer W5LDH from the Delta Division, answered my letter at all. Phil sent me a copy of the results of his ballot on 499, mentioning that Huntoon refused to publish it. No one showed even a slight interest in upping the ARRL income.

Point two of The Amateur's Code has always bothered me a bit. "The Amateur is Loyal . . . He owes his amateur radio to the American Radio Relay League, and he offers it his unswerving loyalty." Back in the early days of amateur radio there is no question that Hiram Maxim did preserve ham radio. But during the 28 years that I've been following the hobby I don't know of any instance where the ARRL saved ham radio. What has the present generation of HQ men done to earn our unswerving loyalty?

Back in 1958 there was growing concern over the 1959 Geneva Conference and ARRL's lack of any program to counter the almost universal demand for a reduction in the amateur bands. When I talked with the heads and important officials of clubs in Europe I found them extremely critical of ARRL leadership. In 1959 I attended the Geneva Conference as a delegate and watched the miracle which saved our skins: the USSR and its satellites supported the U. S. proposal to put off frequency allocation changes until the next conference.

On my visit to Europe last October I did not find any increase in confidence in ARRL. The problem seems mostly to be a lack of any program. First reports of the IARU Region 2 meeting in Mexico City in April tell us that the delegates from South and Central American radio clubs listened to Hoover and Huntoon try to explain the ARRL/IARU "program" and ended up so furious that they refused to join the IARU Region 2 and set up their own separate organization, complete with officers (Antonio Pita, president) the Interamerican Amateur radio Union. They did permit the ARRL to join as long as they picked up 90% of the bill ($4500 worth of crow eating) for the meeting. Tempers flared and I understand that Hunty had to be shut up by the Panamanian delegate and was told that if he had anything else to say, to say it through his delegate, Mr. Dennison. (If I have any distortion of the actual facts I am most anxious to get corrections.)

73 is still unacceptable as an exhibitor at the Convention. Several manufacturers have written to say that they are going to pass it up as a result. I understand that the ARRL Directors were told that Harry Dannals W2TUK will be he official whipping boy for this one. Good

choice. Should he decide to run for Hudson Division Director this fall we'll bring you a fascinating resumé of this guy.

Amateurs visiting the Fair will want to see the ARRL Sponsored station K2US in the Coca-Cola pavilion. It is difficult to find without exact instructions for it is well out of the path of the normal Fair goer. When you enter the Coca-Cola pavilion do not follow the main stream of the crowd off to the left, instead look for a stairway over on your right. Go up two and a half flights and then you'll see a small room with a place for a few people to peer through the glass. Only official HARC ops can operate the station, despite the ad in QST that all you have to do is show your ham license and you can operate. It is hard to believe the reports that the $75,000 a year man for Coca-Cola who made the deal with Hunty was forced to resign as a result. I don't know why Hunty decided that only Hallicrafters equipment could be used at K2US and I don't believe any of the explanations I've heard so far. It is a shame that Hallicrafters had to get stuck in the middle of this.

Enough people got upset over this whole matter so that the Pan American Radio Club in New York got permission to set up a ham station right on the ground floor of the Venezuelan Pavilion. This station, set up with equipment by National, Galaxy, Hammarlund, Waters, etc., will be on view to the millions of Fair goers and should accomplish the purpose of the ill-fated ARRL exhibit. The call of this station is WA2USA. All of us should be thankful for the interest and industry of this club which has resulted in ham radio really being seen at the World's Fair.

I notice that attention is being called to calls other than W2NSD that I have. The big station on 73 Mountain is licensed as W2NSD/1. The station at our HQ building is K1FYP. I also have a CB call of 2W3519 which was used last year in the hunt for a lost boy on 73 Mountain using two Johnson Messengers. I also have NØAOE in Navy MARS and used to have AF2NSD, XEØNSD, W4NSD,, FL8NSD, KC4AF, FØ8AS and others.

Speaking of the Mountain, we got back up there the other day for the first time since the snow melted and found that everything was in good shape. All of the towers and beams were still up in place. With the great emphasis that we are putting on the Institute I didn't see how we would be able to get the shack set up in time for the June QST contest. The 288 element two meter beam still has to have feed-

(Turn to page 75)

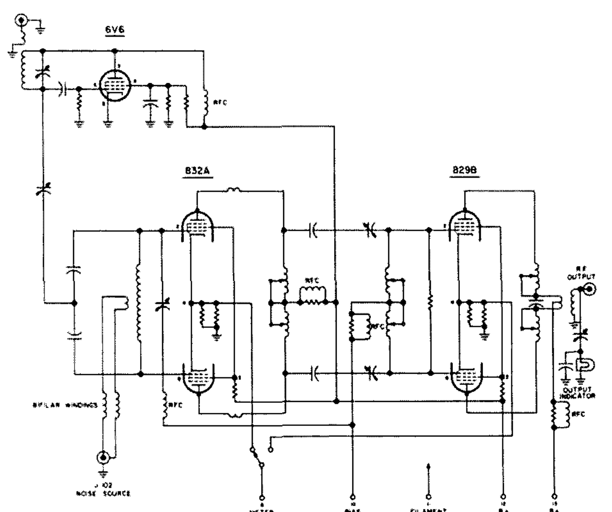
6 Meter AM and SSB Transmitter from the T-51A/ARQ-8

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The T-51A/ARQ-8 transmitter was one of a series of Radar Jamming units used in WWII. Exact operating details of this transmitter are not known to the writer but apparently consisted of a variable self-excited oscillator tube (6V6), driving on 832A mixer stage and this in turn driving the final 832A, or in some cases, an 829B. A noise source was injected into the 832A mixer stage via its grid circuit and mixed with the excitation from the 6V6 oscillator tube.

The frequency range was from approximately 30 mc to 100 mc, and made use of roller coil inductors (rollo coils), rather than the conventional LC circuits. This enabled the unit to cover this wide range of tuning. Some of the equipment came equipped with an 832A in the final stage and some units contained an 829B tube.



TUNING RANGE 30-100 Mc
FIGURE 1

Original schematic

Upon inspection, it was felt this transmitter could be modified into a decent 50 mc unit without too many changes. This was done some four years ago and has since rendered excellent service. Actually, the unit is easily converted into an SSB exciter as well, and this was done at the same time with a second identical unit. The SSB version will be described later.

As an AM transmitter and/or exciter, this modified unit can use either an 832A in the final with an output of about 20 watts, or an 829B, with up to about 60 to 65 watts output. This represents 100 watts or so input power, in the latter case. This is the condition which we will describe.

The original circuit was wire traced and is drawn out in Fig. 1. The modified 50 mc AM transmitter is shown in Fig. 2. On the modified schematic, the original components are left unmarked, while the added or changed parts are so indicated with their values. This modified unit may be modulated, and if so, a modulator of about 50 watts or so will be required. The 829B operates as a Class "C" amplifier. A jack is provided for CW operation—and under such operation, the input can be jacked up a bit higher still, without damage to the 829B. Should the transmitter be used as an exciter to drive something more powerful, the T-51A/ARQ-8 plate voltage may be reduced until the minimum desired power output is reached to properly drive the high powered final.

Modifications

The photograph will show that the T-51A/

ARQ-8 has been mounted on a standard 7 inch rack panel by providing a square cut-out on the left and then fitting in the panel of the unit. It will be necessary to provide some additional enclosure shielding, since the original unit contains nothing in this line—having fitted into another type of case configuration. The rear photograph shows the works, less the aluminum back cover plate, but the shielding requirements may be gleaned nevertheless.

The first step in the modification process will be to scuttle the self-excited 6V6 oscillator tube and insert in its place, a crystal-controlled oscillator-doubler using a type 6AG7 tube in a familiar grid-plate arrangement. The crystal used is the common 8+ mc variety, and the 6AG7 plate coil is resonated to the second harmonic of the crystal, or 16+ mc. From this point, the excitation at 16 + mc is fed into the rearranged 832A tube which formerly was a mixer, but now will function as a push-pull tripler to 50 mc. This tube will in turn drive the final 829B stage as the straight through Class "C" amplifier.

The 832A tripler tube is lightly loaded and easily provides the necessary excitation to the 829B stage. In the grid circuit of the tripler the original grid coil is changed out to another type and the link from the 6AG7 is fed into the middle of this new coil. The 832A tripler plate circuit will use the original rollo coil. About 250 volts dc is ample for this stage plate supply.

The 829B final stage comes in for a bit more of a change, especially in the plate circuitry. The grid circuit of this stage will again use the original rollo coil for its tuning but the plate circuit makes use of a new LC combination. The reason is this: when the input power to the final 829B is stepped up to around 100 watts or so and the output runs in the vicinity of 65 watts, the original rollo coil in the plate circuit exhibits a bit too much heating and the rather small sliding contacts used in contacting the individual turns of the coil may start arcing when the unit is tuned under power. This condition cuts down on the efficiency of the final stage and prolonged transmission causes excessive heating. It was felt best to provide for something a bit more husky. This took the form of a dual-section, double-spaced variable capacitor and a new tank coil made of No. 12 enamelled wire, with a new two turn output link. If an 832A is substituted in the final, or if the 829B tube is throttled down in power input, this change in the final tank coil will not be necessary. No decrease in efficiency was noted when the power output was in the order of 20 watts or so, nor was heating any problem, so the removal of the original rollo coil will depend on just how far the user wishes to push the final stage.

Referring to the modified schematic, the only other additions of any import would be

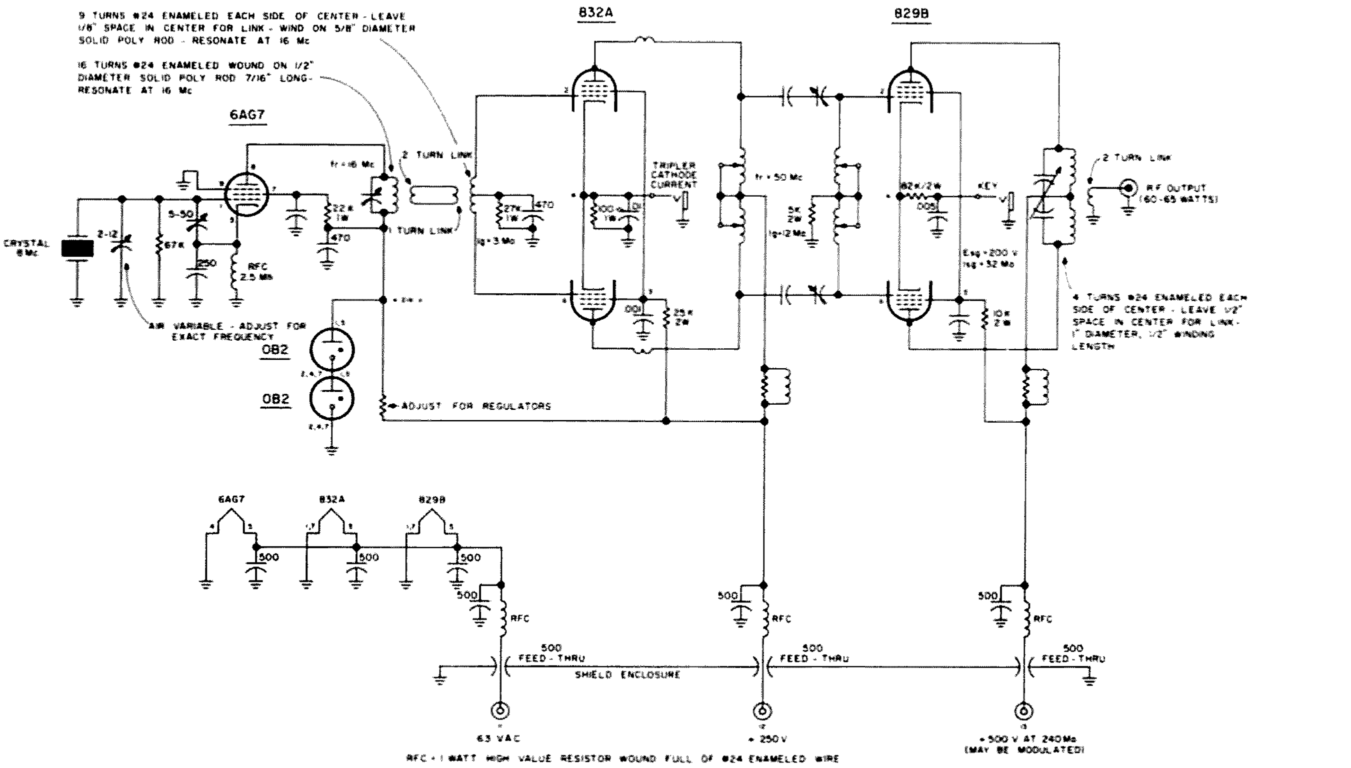
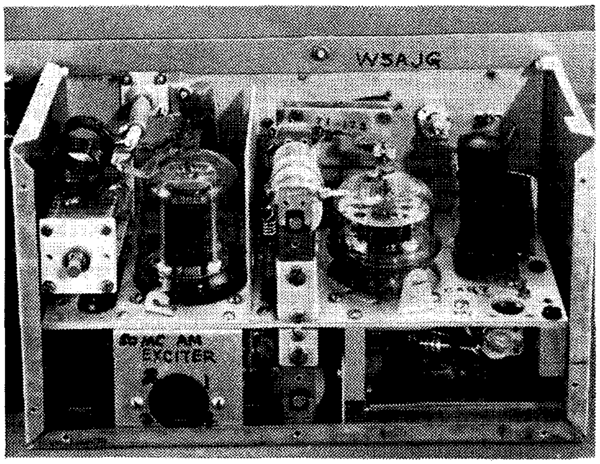


FIGURE 2
Modifications for AM



Rear view of T-51/ARQ-8 unit.
829B final on left of partition. 832A tripler and 6AG7 osc-doubler on right.
New 829B tank coil and capacitor can be seen, with output link tied into the coax output receptacle.
On the right the 6AG7 xtal oscillator and doubler tube replaces the original 6V6 self excited oscillator. The xtal trimming condenser is mounted on the panel. This allows exact freq. operation on nets, etc. (MARS). A box is formed of aluminum for shielding. The back and top plates are removed for the photo. Power if fed in on the 4 prong receptacle.
Note: Since photo was taken, the above 4 prong receptacle has been replaced with a 5 prong MALE receptacle for safety purposes.

the filtering of the power leads. This is, of course, to obviate the TVI problem. This work may or may not be necessary, according to location and suspectibility to such trouble. No particular problem was encountered in this area after the shielding was incorporated. The filters in each power lead were inserted on the rear of an ordinary 4 prong receptacle carrying the voltages.

Operation

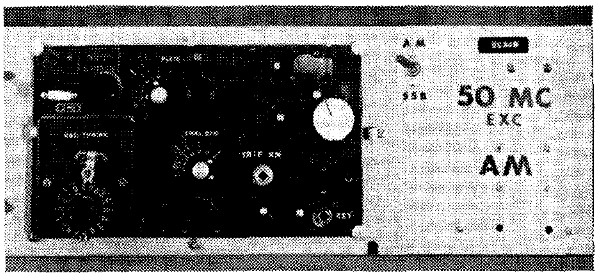
All coils are grid-dipped to their proper frequencies—the 6AG7 crystal stage output coil resonated at 16+ mc along with the new grid coil of the 832A. The original rollo-coils in the plate of the 832A and the grid of the 829B may be approximately set with the front dials to 50 mc and then grid-dipped to exact operating frequency. The newly added LC circuit in the plate of the 829B will also have to be checked and adjusted to 50 mc.

After this has been done, power may be applied and if no wiring errors have been made, all should operate as planned. Some sort of dummy load or wattmeter should load the 829B stage, before full power is revived up. The tripler cathode current will measure about 20 to 25 ma, while the final 829B cathode current (measured in key jack) may be run up to 240 or 250 ma or so with about 500 volts on the plate. This value will include 30 or 35 mills of screen current. Grid current to the final should measure 10 to 12 ma.

The low voltage tap of 250 volts dc should be capable of around 50 ma and may be a separate supply or any other way of providing such capability. Keying may also be accomplished by inserting a key in the "Tripler Cathode Current" jack if cut-off bias is furnished for the 829B final tube. This would be in the order of some 50 volts or so.

Should the unit be used as a complete AM Phone transmitter, the modulation transformer secondary should be inserted between terminal 13 and the power supply. Here at W5AJG this unit is used to drive a push-pull 4X250B final amplifier to 600 watts input when high-level, Class "C" AM operation is desired. The rf drive requirement in this instance is only approximately 10 watts or less so the T-51A/-ARQ-8 just loafs along. The actual plate voltage on the final is reduced ot 250v and plate current runs about 90 ma for our particular requirements as an exciter.

When it is desired to use the 4X250B final as a KW PEP linear in SSB service, the second T-51A/ARQ-8 unit modified as an SSB exciter-driver is switched into service in place of the above described AM unit.



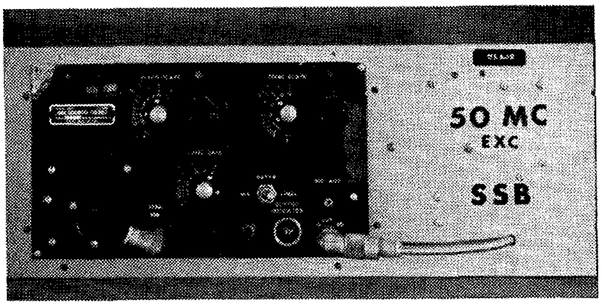
Front panel view of the T-51A/ARQ modified unit.
A square rectangular cut-out in the rack panel is made to fit the unit into.
The white knob is the control for the new 829B LC tank circuit. A tripler MA jack is added in the place formerly occupied by a meter switch, which is no longer used.
The key jack is added in the place formerly occupied by the coax output RF receptacle. The new location of the RF output receptacle is just above the white knob.
The AM-SSB switch switches power from this unit to another identical unit, modified for SSB service.
The crystal sockets are installed on the rack panel for convenience. There is one on the inside of the unit but it is inconvenient to change crystals. Two different xtal sockets are wired in parallel so as to accommodate surplus type as well as FT243 type crystals.

SSB Conversion: Another identical T-51A/-ARQ-8 unit was converted into a 50 mc SSB exciter or transmitter. Using the same technique of changing final amplifier tube types, the PEP SSB input can be anything from about 35 watts to 150 watts. Should the unit be used as a driver for a higher powered AB1 amplifier, the output can be lowered by using the smaller final tube, while the larger tube may be used should the T-51A be utilized as a complete transmitter.

Modifications

Since the requirements at this station dictated the modified unit be used for exiciter service to drive a 4X250B push-pull final, running the maximum power, the drive requirements were very modest and the lighter 832A tube was used in the final stage, instead of the heavier 829B tube. However, both conditions will be described and typical characteristics will be listed.

Referring to the two photos and the unmodified schematic as well as the modified schematic (Fig. 3), it can be seen that this conversion, like the previous one, mounts the unit on a standard 7 inch rack panel, in precisely the same way as before. Also followed, is the identical arrangement of enclosure shielding on the rear of the panel. The rear view illustration shows this once again, with the top and back aluminum shields having been removed.



Front panel view of modified T-51A/ARQ-8 unit. Unit is mounted on a standard 7 inch relay rack panel. Original oscillator tuning capacitor dial has been removed. 21 mc SSB input energy goes into the coax receptacle so marked.
The phone jack is for the plugging in of a mill-meter to measure cathode current of the mixer and final.

The first step in this SSB conversion will be to replace the original 6V6 self-excited oscillator tube and substitute a crystal controlled oscillator-buffer stage using a type 6U8 tube. Before we do this however, a word about the proper injection frequency and the appropriate crystal frequency necessary.

All VHF SSB work at this station is done with a basic Central Electronics 20A unit and at an output frequency of 21 mc. Therefore, the wanted crystal injection frequency will be around 29 mc. Since the 50-54 mc band will take in 4 mc and since vfo used with the 20A does not cover but 500 kc, it will be necessary to have more than one crystal to use with the T-51A unit if the full 4 mc range must be

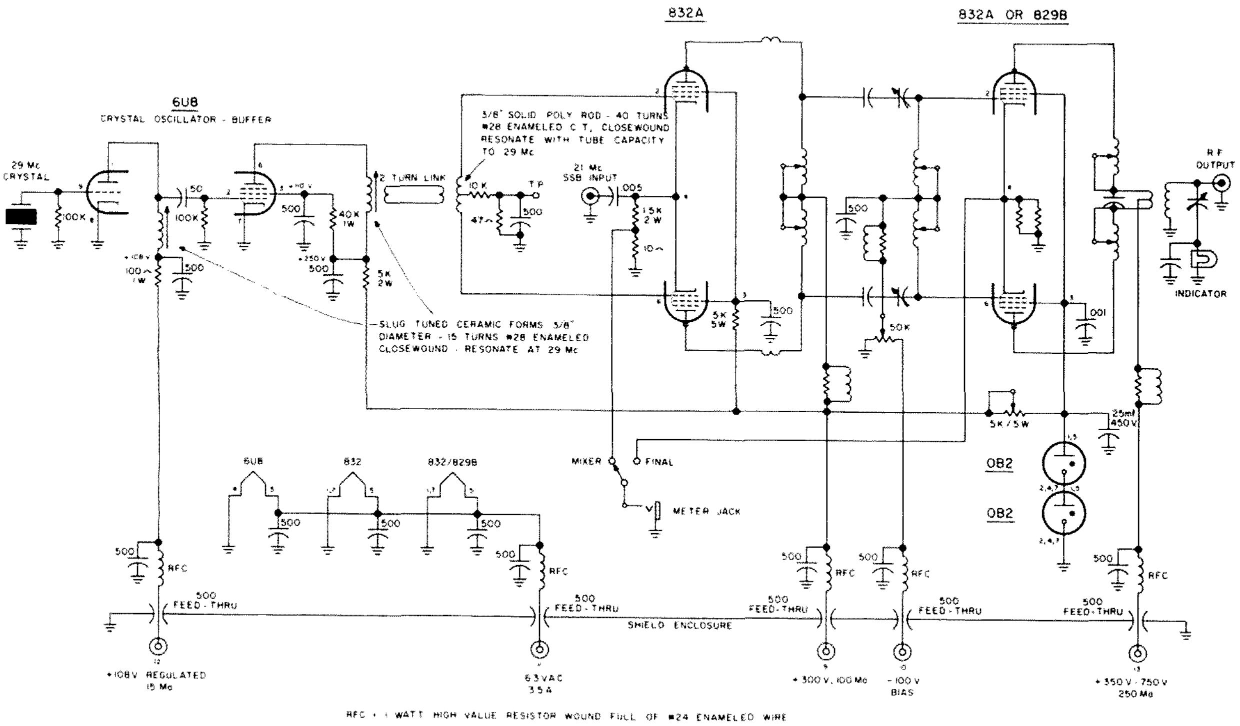


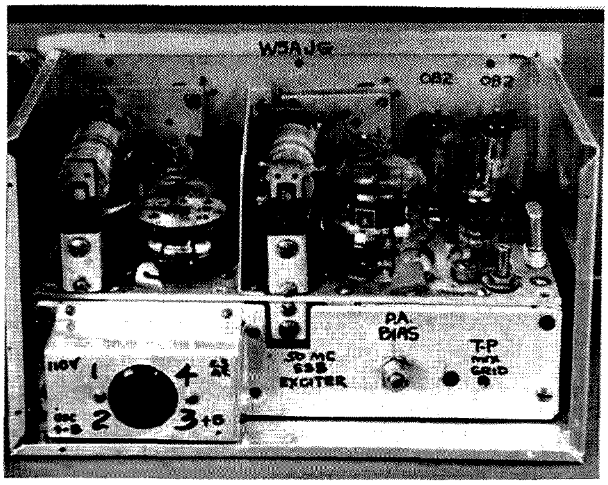
FIGURE 3
Modifications for SSB

covered. This is a common occurence these days, even with expensive manufactured equipment. One will just have to choose the portion of these wide bands that most appeal to his needs and furnish crystals to cover these segments. Since most side-banders on 50 mc still seem to favor low end operation, it will probably be the most desirable to cover the first 500 kc of the 6 meter band, at least for a start.

This being the case then, a crystal of 29 mc for the injection string will be used. This added to the 21 mc SSB from the 20A will mix in the first 832A mixer tube to produce the desired 50 mc output. The final 829B (or 832A) will then serve as the class AB1 linear output stage.

Other frequencies than 21 mc for the SSB energy may be used, of course. 14 mc is widely employed for this same purpose from the SSB generator and should this frequency be desired, it will merely be necessary to change the crystal string to 36 mc, instead of the 29 mc as shown. This merely involves three coil forms and is of small significance.

Back to the 6U8 oscillator-buffer. For good stability, the oscillator plate voltage supply is regulated at 108 volts. This low voltage is entirely adequate as the pentode section of the 6U8 will furnish sufficient drive for the 832A



Rear view panel photo of the T-51/ARQ modified unit.
Final shows 832A tube in place, but 829B tube may be inserted for additional power output. New 6U8 xtal-oscillator, buffer tube at right. 29 mc xtal also seen. OB2 regulator tubes in series, regulate the final screen voltage. Capacitor with slotted shaft is not used and has no function.
Power input is 4 prong socket at left. Since photo was taken, this female socket has been changed to a male type for safety reasons.
The 110V (Pin 1) on this socket is fed from a small 6.3v to 115v transformer reversed. This transformer is located at another point than the unit itself, and is not visible in this photo.

mixer grid. A couple of ordinary slug tuned coils are utilized in this stage. They should resonate at 29 mc and the output buffer has a link of a couple of turns on its cold end to couple to the new 832A mixer coil. This added coil is also resonated with tube capacity to 29 mc. Normally, no external front panel tuning is necessary on this stage and when the slugs are once set for maximum output, they need not be changed unless one moves a megacycle or so; therefore, the original tuning dial for the old original 6V6 stage is removed from the front panel.

The 21 mc SSB input from the 20A is injected into an existing coax receptacle, marked OSCILLATOR, mounted out front, but it is rewired into the 832A mixer tube cathode instead of into the grid circuit as per the original installation, (J102). An effort was made to use the same type injection scheme as per the original installation—that is, mixing the injection frequency as well as the external frequency (SSB) in a common point through the original bifilar wound coils and J102. While this did work after a fashion, instability was encountered with certain setting of the rollo coils. Apparently a TNT action took place. With cathode injection of the SSB energy, no instability could be made to occur with any setting of the tuned circuits. Control grid as well as screen grid injection of the SSB energy were also tried and all were about on a par with cathode injection, so any method could actually be used. Cathode injection is easy to accomplish. Any SSB exciter like the 10B or 20A with a few watts output is sufficient for driving.

To continue: the 832A mixer plate circuit will use the original rollo coils, as well as the grid circuit of the final tube. Plate and screen voltage on the 832A mixer is derived from a power supply of 300v capable of about 100ma drain. This supply will also furnish power for the pentode section of the 6U8 buffer, and in conjunction with a couple of series OB2's (regulators), the screen voltage for the final tube screen.

The plate circuit of the final tube will likewise use the original rollo coils and as stated in the preceding on the AM version of the T-51A, no heating will be experienced in this low duty cycle SSB work, which is in contrast to the heavy duty cycle of AM type operation. Therefore, the output circuit of the final will remain practically intact, even to the existing indicator (rf) light feature, should you find this is attractive. It will be necessary to provide some fixed bias for the final 832A/829B linear stage. This can be conveniently done with a small silicon diode rectifying the 115v ac provided by a reversed 6.3 to 115v ac transformer, and providing a variable pot for proper adjustment. This pot is mounted on the rear apron of the chassis and the negative bias of about −90 volts is brought in on terminal 10 of the original terminal strip. The proper adjustment of this control will be covered very shortly.

The original meter switch is left intact on this version of the unit and in conjunction with a jack installed on the panel, is convenient to check the cathode currents of the mixer and PA stage. Other details of construction, such as the necessary shielding and the filtering of the power leads will be identical with the previously described unit.

Operation

Install either the 832A or the 829B in the final stage according to power output required. Plate voltage should be supplied from an external source of from 500 to 750 volts maximum. For full output, the supply should be capable of about 250 ma or so. The only change necessary from using one tube or the other will be the screen grid dropping resistor from the 300 volt supply. This will have to be adjusted a bit to provide proper operation of the OB2 regulators. This variable resistor can take the form of a 5k, 5 watt unit and will allow either tube to be used.

All the coils are grid-dipped to their proper frequency. The two slug tuned coils associated with the 6U8 want to resonate at 29 mc approximately. Same for the grid coil of the 832A mixer. The rollo coils of the mixer plate, the final grid and the final plate, will of course, be set at 50 mc. This can be done fairly closely, for a start, with the front panel dials.

After this has been done, power may be applied and if all wiring is OK, things should start to happen. To begin with, do not apply any SSB energy. With the switch set to check the cathode current of the final stage, set the negative bias pot until the resting cathode current is about 18 or 20 mills. This will do for now. The test point "T-P" in the mixer grid circuit may be checked at this point, and the crystal injection string from the 6U8 peaked up, until a maximum is indicated, as read on a sensitive VOM. Checking the cathode current of the 832A mixer should show around 15 mills or so. No output should be observed from the final as yet.

Now connect the SSB 21 mc input up to the front panel coax-receptacle and turn on the 20A or whatever unit is used. Crank in a bit of re-inserted carrier and trim the three rollo coils until some 50 mc output is indicated in

the dummy load or wattmeter or whatever is hooked on to the unit. At this point, all coil slugs, rollo coils, 20A output circuits, etc., should be peaked for maximum 50 mc output from the T-51A. From here on in, everything should be more or less routine and adjustments of voltages and output may be set as desired. It will be advisable to let the triode oscillator section of the 6U8 tube run continuously between transmission for the best SSB stability.

As for power delivered: should the 832A be used in the final, an input of about 35 to 45 watts may be used. This will result in an output of around 17 to 20 watts PEP and will be more than sufficient to drive any type of grounded cathode final to maximum power. In actual practice, here at W5AJG, the plate voltage on the 832A final is run at about 375 volts and an input of only 10 or 11 watts is needed to produce the 4 or 5 watts PEP output necessary to drive the station final, which is a pair of 4X250B's in push-pull, to more than a KW PEP input.

Should the T-51A be used as a complete transmitter without another higher powered final, then of course the choice would be the 829B tube in the final socket. This tube will allow an input of some 120 to 150 watts PEP and will deliver on the order of 65 to 75 watts PEP output. This unit was checked out with an 829B tube and a plate supply of 600 vdc. The screen was of course regulated at 216 volts. Final bias was −30v. Resting plate current was 20 mills. With a two-tone test signal driving the final plate current to 100 mills, an output of 40 watts was measured. Speech easily drives the PEP output to the above 65 watt figure, when up to 750 volts is applied to the plates of the final. The rollo coils will hold tuning over a range of about 400 kc before re-adjustment becomes necessary.

A standard Drake transmitting low-pass filter (TV-1000-LP) is used on the output of this transmitter when feeding the antenna. No trouble with TVI in this area was encountered. Channels in use being 4, 5, 8, 11 and 13.

Some workers have reported an interesting variation in the modification process on such a unit as this. Instead of using the 6U8 oscillator-buffer stage as described above, an International Crystal Company ready-made unit, such as the 200-125, or an earlier version, was installed. This was accomplished by removing the 6V6 oscillator tube and all components associated with it, and sub-mounting the assembly under the chassis. The hole left by the 6V6 tube socket removal allows the 6AU8 tube to protrude slightly above the deck.

Many thanks to K5KLU for his help in the modification and the testing of the T-51A/ARQ-8.

. . . W5AJG

The Nickel-Cadmium Storage Battery

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You have probably noticed in the surplus columns of various Ham magazines that nickel-cadmium batteries have finally become availabe at reasonable prices. In case you have been looking for a compact, reliable, portable and re-chargeable source of power, you should consider these devises. The purpose of this article is to supply you with the information you will need to make proper use of these little wonders.

Specifications
(For the BB-403 series)

1. Dimensions: Approximately 2" W. x ½" D. x 6" H.
1. Capacity: 4 Ampere hours at 1 ampere rate.
3. Voltage: 1.2 Volts per cell.
4. Venting presure: 1 to 3 PSI.

While the ampere hour rating is 4 A.H., it might be interesting to note that these cells will suply peak currents up to about 40 amps. Cells are shipped from the manufacturer with shipping plugs installed in the vent wells. However, the cells you will buy should have *vent* plugs installed. These are in the form of hollow screws, around which rubber sleeves are fitted, and are designed to release gasses produced while charging the cells, and to prevent foreign material from entering the cells, or electrolyte leakage.

Life expectancy of these cells is not precisely known. However, I understand they should

last in excess of 20 years!

Preparation For Service

Carefully examine cells for cracks, and if any are evident, fuse the cracks with a hot soldering iron. Then clean the cells thoroughly with distilled water and a brush. Wipe dry or allow to air dry, remove vent plugs and soak them in distilled water for at least an hour. Check electrolyte level and add electrolyte if necessary to bring level up to ½" over the tops of the plates. Do not raise level more than ¾" above the tops of the plates, as the solution will rise during charging.

Electrolyte consists of a 33% solution of potassium hydroxide in distilled water and may be purchased from your local pharmacy. This solution is very caustic and will wreak havoc with anything upon which it is spilled; it is also very poisonous and should be kept in a clearly labeled bottle far from the reach of children.

Addition of electrolyte to cells is easily accomplished by filling the vent wells while squeezing the cells and then releasing the pressure applied by squeezing. An eye dropper is very handy for this operation. It is probably wise to discard any eye dropper used for this purpose. After electrolyte level has been adjusted, replace the vent plugs and tighten securely.

Equalization

Equalize cells by discharging at a 4 ampere rate until voltage reaches 0.9 volts. Short cells and leave shorted for at least one hour. Allow cells to cool before charging, then charge according to one of the following procedures.

Charging

If the state of charge of individual cells is not known, always equalize, using the procedure described above. Generally, if cells have been inactive for more than two weeks, or if they have been floating (trickle charging) for more than a month they should be equalized. This is particularly important if you wish to charge cells connected in series.

Method 1: (Constant Current) Charge at 1 ampere for minimum of 5.6 hours.

Method 2: (Constant Current.) Charge at 0.8 to 2.0 ampere until cell voltage reaches 1.55 volts; continue charging at 1.3 amperes for 1 hour.

Method 3: (Constant Voltage.) Charge at 1.5 volts for 1 hour. This method is recommended when cells are completely discharged and rapid restoration is important.

Method 4: (Constant Voltage.) Charge at 1.5 volts for 1 hour. This method is recommended when cells are not completely discharged, are in a questionable state of charge, and when a full charge is not required.

CAUTION: When using constant voltage methods, the charger should be capable of supplying peak currents in the order of 40 amperes and continuous currents of 6 amperes.

Method 5: (Trickle charging or floating.) In order to maintain cells in a fully charged condition, charge at a constant current of 15 to 30 milliamperes, or float by connecting cells to a constant voltage buss which will supply 1.55 volts. These procedures are useful when cells must be used occasionally, and relatively long periods of activity will allow cells to charge back to full capacity at a slow rate. However, after several months of floating or trickle charging, cells should be equalized and recharged, using one of the constant current methods of charging if possible.

Determination of State of Charge

No exact method exists for measuring the state of charge of a Nicad battery. However, the following techniques are reasonably accurate and will indicate the relative state of charge.

Method 1: (Most accurate.) Connect cells to a constant potential buss supplying 1.5 volts. After 5 minutes, connect an ammeter in series with batteries and buss. If current is less than 0.2 amperes, you may assume the cells are fully charged.

Method 2: (Least accurate.) Measure cell voltage. A fully charged cell should produce about 1.3 volts; a fully discharged cell should produce about 1.15 volts.

Periodic Checks and Maintenance

After cells have been in continuous service for 3 months, equalize, clean, adjust electrolyte level and charge as described previously. If electrolyte level was low, try to determine the cause of this condition. If no evidence of leakage is present, low level is probably due to excessive gassing and resulted from charging at high currents. Generally, white deposits *in* the vent wells (potassium carbonate) indicate loose vent plugs or excessive gassing and may be considered normal. White deposits *outside* the vent wells indicate that electrolyte has escaped the vent wells. The point here is simply this: if elctrolyte has been lost, *electrolyte* should be used to bring level back to normal. If level is low due to gassing only, add *distilled* water, as the chemicals were not lost and addition of electrolyte will result in exces-

sive electrolyte strength.

You may now test the capacity of the cells by discharging at a 4 ampere rate and observing voltage drop over a one hour period. After one hour, voltage should be at least 1 volt. Any cell which does not pass this test is defective, or possibly does not contain sufficient potassium hydroxide. You may attempt to salvage cells by adding an aditional ½" of *electrolyte*, equalizing, charging and testing again. A cell which fails the test three times is not up to par.

It is also important to allow cells to rest for 48 hours between charging and testing; failure to observe this rest period will not damage cells, but will introduce errors into the results of dischage tests.

Following tests, charge cells and return to service, or place in storage.

Storage

These cells may be stored in *any* state of charge, and at temperatures ranging from minus 55 degrees C. to plus 75 degrees C. Self-discharge will occur at the rate of approximately 10% of the initial charge per week at temperatures below 50 deg. C., and will occur much more rapidly above this temperature. Cells which have been in storage for longer than 2 months should be equalized, inspected and charged before being returned to service.

When cells are to be stored for long periods of time, all metal parts should be coated with vaseline or light grease, and the vent plugs should be tight.

Conclusion

Uses of these cells are countless. I have built at least a dozen gadgets using transistors since my purchase of the cells,and have found them to be the most convenient source of voltage levels I have owned. So, adventuresome souls, dash out and buy a few of these gadgets and take advantage of another "fringe benefit" of the space age.

... W4VGS/1

The ARB Aircraft Receiver

getting it operational

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The ARB receiver is a superhet capable of AM, CW and RTTY reception in the range of 195 and 9050 kcs. Actually, its performance probably leaves something better to be desired, but it is capable of being a secondary receiver in a ham station.

The easiest way to power the receiver would be to supply 28 VDC to pins 1 and 2 (ground) on J102 (*power*), thereby utilizing the dynamotor furnished with the receiver. Rewiring the filaments for 12 VAC operation will create problems (without major conversion) as there are 28 VDC relays in the circuit. (If the dynamotor is not to be used, then supply 225 VDC to pins 35 and 36 (ground) on J103 (*accessories*) and 28 VDC to pins 1 and 2 (ground) on J102.) Attach the right angle fitting and tuning knob to the fitting beside the tuning dial window.

INTERCONNECTING CABLE

FROM P-101	TO P-201 (or P-301)
1	1
2	2
3	3
4	4
5	5
6	6
7	7
12	12
13	13
14	14
15	15
16	16

Actually it is necessary only to furnish 28 VDC to the receiver, to attach the tuning knob to the receiver, and to make up a simple cable to utilize the remote CW switch and volume control that is contained in the remote head.

Select the pilot's control box (shown in the TM on page 85) and make up one cable to connect the control box to the receiver (J201 *control box*). The cable is a reduced version of W401 on page 113 in the TM. Keep the cable simple. Do the band switching manually at the receiver and thereby reduce the current requirements of the 28 VDC supply. The control box will be used to turn the 28 VDC on or off, to select the mode of reception, to select MVC or AVC, and to control the receivers gain.

... W1MEG

Adding SSB to the ARR-7

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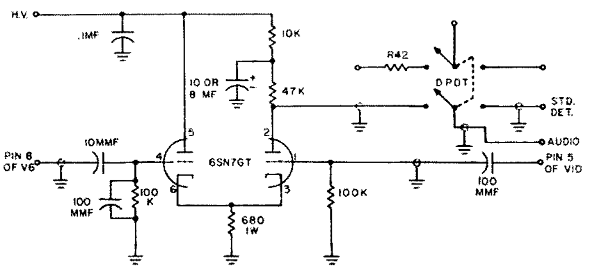
I bought an ARR-7 from R. E. Goodheart after trying in vain to find anything with that complete coverage and overall quality at anywhere near the price. Although Goodheart had already removed and bypassed the reradiation suppressor, this article on adding SSB will be written for those who have an unmodified receiver. For those already possessing one of these versatile sets, or for those contemplating purchase, the ARR-7 is an extremely simple receiver in which to install a product detector.

Proceeding directly to the heart of the matter, the following steps make it possible to modify the receiver in a few hours' time. First, remove and discard the 6AB7 which precedes the first of the two rf amplifiers. This tube was used only as a reradiation supressor so don't worry about losing gain or sensitivity in discarding it. The socket is utilized in the modification and the tube is replaced by a 6SN7 Product Detector.

The front-panel screws are loosened sufficiently to get an end wrench between the front panel and the chassis in order to remove the spst bfo switch. When the nut on the switch has been considerably loosened, the switch may be rotated about, so that with a gun-type iron, or other iron with a small tip, the connections may be removed from the terminals.

Replace the old switch with a DPDT and reconnect the wires removed from the old switch in such fashion that they are switched ON in the bfo "ON" position. Use the uppermost terminals, the ones closest to the top of the receiver, for these connections, the single wire going to the center terminal and the pair of wires going to the other terminal.

Returning to the vicinity of the 6AB7 socket, there is a terminal board immediately adjacent, on which are mounted *79, C80, R54 and R55. Clip off, or unsolder these components so the terminal board can be re-used. Be careful when removing R-55, as this 47K resistor can be re-used as the plate load for the 6SN7. The B lead in the lower corner should also be carefully unsoldered, then the entire board can be removed for ease in installing the new components which consist of a .1 mf capacitor, a 10K ½ w resistor, and the re-installed 47K resistor. The terminal board is modified as follows: Remove the ground connection which runs in the vertical plane and swing it around to the B lug.



While the terminal board is out of the way, the octal socket may be rewired for the 6SN7 as follows: Remove the antenna lead from pin 4 and the lead connected to pin 8. These two leads may now be directly connected by placing them on the unused lug of the terminal board when it is replaced. The jumper going from pin 3 to pin 5 is removed, carefully, from pin 5 and connected to pin 6. If carefully removed, the ground lead connected to pins 1 and 2 can also be reused. A "soldering aid" tool is an asset for this sort of operation. A piece of spaghetti is slipped over this ground lead and it is then connected to pin 8 which takes care of the heater circuit. The other components are now connected to the socket, the 100K resistor from pin 1 to pin 8, the 100K resistor with a 100 pf capacitor across it, from pin 4 to pin 8 and a 680 ohm 1 w resistor from pin 6 to pin 8. (This is the only 1 w resistor; all others are ½ w.) The terminal board can now be reinserted.

When placing the .1 mf capacitor on the terminal board, leave enough lead on the B end and it can be used to connect directly to pin 5 on the octal socket.

Remove the 3 screws from the bfo compartment and remove the cover. Inside you will notice a "gimmick," two wires twisted together; remove these and replace them with a 100 pf capacitor. Remove the lead going from the lug to the 6H6 for bfo injection. Remove the #6-32 machine screw and place a ground lug under this screw and replace the screw. Replace the cover on the bfo.

Prepare a 7" piece of small coax or shielded lead as follows: Strip one end so that about ½" of shield is exposed and about ¾" of center conductor and its insulation. Strip off about ¼" of this insulation exposing the center conductor. This end of the shield will be connected to the ground lug installed on the bfo compartment and the center conductor connected to the lug which formerly went to 6H6. The other end of the center conductor is connected to pin 1 of the tube socket. The 47K resistor from the terminal board can now be connected to pin 2 of the socket.

An 8½" piece of small coax is stripped in the same manner as the previous piece. With a hot iron, a place can be puddled and tinned with solder on the vertical wall of the bfo compartment nearest to pin 8 of the last *if* tube. The shield of the coax is grounded at this point and the exposed center conductor is connected through a 10 pf capacitor to pin 8 of the last *if* tube. The center conductor at the other end is connected to pin 4 of the 6SN7.

Now, on the opposite side of the receiver there is a long terminal board. On it, near the rear of the receiver, is the audio coupling capacitor C77; the lead nearest you is removed and transferred to a blank lug which is toward the rear of the receiver.

Now strip 2 26" pieces of small coax exposing the shield and center conductor at both ends. Strip another 26" piece so that the shield and center conductor is exposed only on one end. This end will be connected to the DPDT switch at the front panel. All three shielded leads can be snaked up through the harness along the right side of the receiver when looking at the bottom of the eceiver, which will tend to keep things neat.

The center conductor of the coax which is stripped on only one end is connected to pin 2 of the 6SN7. The center conductor at the other end is connected to the lug of the unused section of the DPDT bfo switch is closest to the center of the receiver. The center conductor of the next coax is connected to the center lug of the switch and the other end of the center conductor is connected to C77. The third coax center conductor is connected to the remaining lug on the switch, and thence connected to the point that C77 was removed from.

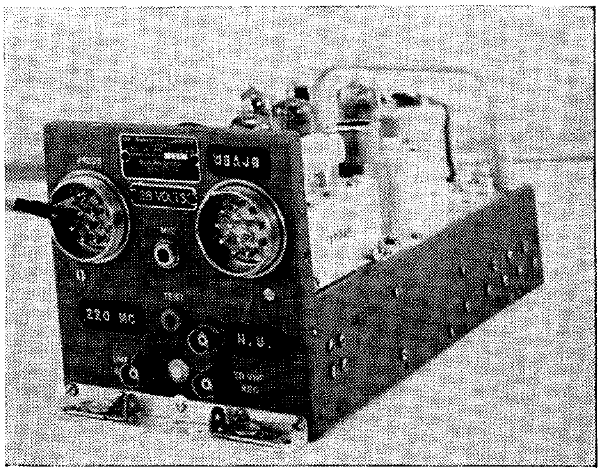
The 3 shields at the point near the switch are wrapped with bare wire and soldered together. The other end of the two leads going to the audio can be tacked together in similar fashion. Where the lead which goes to the Product Detector, goes by the bfo compartment, about ½" of shield should be exposed and connected to the same point as the lead which went to the last *if* (the solder puddle at the side wall of the bfo compartment).

With all leads now installed on the 6SN7 socket, room can be found to connect the 10 mf decoupling capacitor to the ground lug of the adjacent tube. This completes the modification; plug in a 6SN7, hook up the power and start product detecting whenever the bfo is on. This modification does not affect ordinary CW reception, but makes it easy to tune and receive SSB signals. Either side band can be selected by adjustment of the bfo knob. It works like a charm!

. . . W6BHR

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas



The ARC Type TV-10 and 10A

Converting them to 220 mc transverters

The surplus unit designed ARC Type TV-10 or TV-10A Transmitter-Converter, commonly known as a Transverter, is built by the Aircraft Radio Corporation and is known generally as ARC Type 12 equipment, or ARC Type 220 UHF Portable Communicator equipment. In the military, it is also designated as a Frequency Converter-Transmitter CV-431/AR.

As used in this instance, a transverter performs in one unit the functions of a transmitter and receiving converter. The transmitter is of course on the desired frequency on which one wishes to send, while the receiving converter translates this frequency to an existing receiver of another frequency.

For instance, these equipments normally transmit on a fixed frequency or frequencies between 228-258 mc, and transforms or converts the reply in this same frequency range, to a new rage of 118-148 mc, so as to enable existing receiving equipment to be used. In ham talk, this is a crystal-controlled transmitter combined with a crystal-controlled converter, contained in one case.

Our interest here is to convert the unit to something usable in the 220-225 mc ham range by utilizing the crystal-controlled transmitter and converting the received 220 mc signal to the 144-148 mc range, so as to make use of the existing 2 meter receiver in the station.

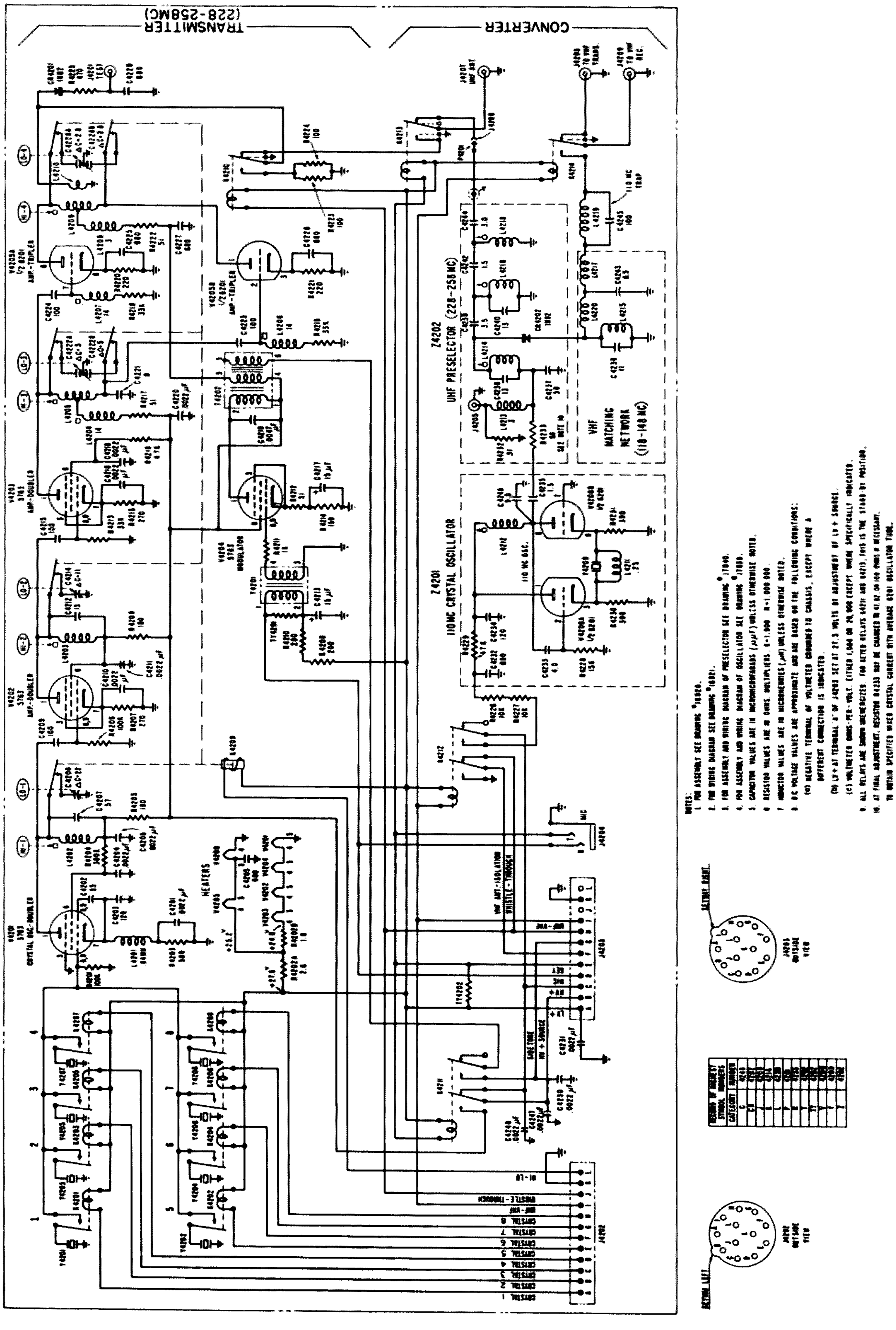
There is a little difference between the Model TV-10 and the Model TV-10A. The former has a rated transmitter output of one-half watt, while the latter is rated at a nominal two-watts output. The receiving converter section is identical in both units.

With a few modifications, this little unit will enable one to operate low-power on 220 mc, without installing a separate 220 mc receiver. It is very light in weight and may be worked in a mobile capacity if desired. Although low in power output, several uses suggest themselves—such as CD nets, RACES tie in—and so on.

Modifications

The amateur 1¼ meter band is a rather wide one and different parts of the frequency range are used in different localities. In an effort to split the difference, a design frequency of 225.5 mc was chosen, which represents the midpoint of the assignment.

Transmitter: A schematic diagram of the original TV-10 unit is reproduced and may, for all practical purposes, be used for the Model TV-10A also. The first order of business is the tube heaters. This equipment is designed for 27v dc operation and if either 12v or 6.3v is desired instead, some changes must be made in this wiring. This is rather routine and inspection of the schematic and the actual


TRANSMITTER
(228-258MC)
CONVERTER
Z4202
UHF PRESELECTOR (228-258 MC)
Z4201
110MC CRYSTAL OSCILLATOR
VHF
MATCHING
NETWORK
(118-148 MC)
HEATERS
NOTES:

unit will suggest the best way for your case. Of course, the simple way out would be to continue to use the 27v dc. This is not as difficult as it once was—what with all the silicon devices around able to handle a couple of amperes without sweat. If it is desired to use ac however, the mike line will have to be disconnnected and rerouted to some source of mike current.

Relays: The next items to be considered are the relays. These are also 24 V dc operated and of course ac will not work here. Fortunately, all of the relays will not be used. Most will remain in the circuit but in their normal un-energized position, and in which case, one side of the coil may be disconnected to keep them from operating. A couple will be used in their energized position. This may be accomplished by blocking the armature closed with a tooth-pick or other suitable means, along with disabling the coil by the disconnect procedure as on the others. Actually, the only relay that would be of value would be the antenna change-over relay. If it is desired to retain this one, it will be necessary to provide 24v dc to operate it. Following is the relay schedule:

Disconnect one or both sides of the coils of every relay in the set, causing them to be disabled, with the exception of the antenna change-over relay K4213. Block in a closed position the two relays marked K4211 and K4214. Further details on some of the individual relays will be given shortly.

Power Supplies necessary: As above mentioned, if 24v dc is available and can be used, much work will be eliminated. Without the relays, about ¾ a will do the job. If 12 volts are used, 1.5 a will be necessary and if 6.3v is used, about 3a will have to be provided. The plates will require 250-275v dc at about 130 mills for the ½ watt output.

On the power receptacle J 4203, the filament heater voltage will go to terminal "A" marked LV+. The B+ will go to terminal "B". The microphone transformer primary T4201 will have to be isolated and fed to the mike being used. Terminal "E" will key the antenna relay by grounding same. When the transmitter is in stand-by position and B+ is not being fed to terminal "B", it will be necessary to get voltage to the receiving converter. This could be accomplished by connecting a wire from the bottom of R4227 to an unused terminal on J4203, such as "L", and feeding the converter voltage at that terminal when receiving and to terminal "B" when transmitting—or perhaps some other arrangement will suggest itself that would fit in better with individual

existing available power supply facilities or switching.

Circuitry: The original frequency range of the transmitting crystals used to cover the 228-258 mc segment was between 9.5-10.75 mc when using a multiplication of 24 times. An alternate multiplication of 36 times could also be used in the gear and in that case the crystal frequencies would be between 6.333 and 7.166 mc. Either arrangement was permissible and satisfactory.

To provide the newly desired output frequency of 222.5 mc a crystal of either 9270.8 kc or 6181.481 kc will be necessary. The latter frequency rock was available at this station and was a surplus one of the type that was used in the old SCR-522 two-meter equipment. Using either crystal, however, no alterations in the rf circuitry are necessary. Merely retune the coils and/or capacitors for maximum rf output at Test Jack J4201 on front of the unit. A small range mill-meter may be used here for the best indication. Also a lamp load could be used for testing and for the tune-up. Select one of the crystal socket positions, insert the 6181.481 kc crystal and block closed the associated relay. The other crystal sockets and relays will not be used.

The 220 mc antenna will connect to J4207 labelled UHF ANT. J4208 labelled to VHF TRANS will not be used. J4209 labelled to VHF REC will be used to go to the 144 mc station receiving equipment. This is the output of the converter section of the TV-10 after the signal has been translated from 220 mc to 144 mc.

Receiving Converter Section: Refer again to the schematic. Note that Z-4201 is an 110 mc crystal oscillator. This 110 mc crystal is actually a *7th overtone type*, with inductor L-4212 resonating on the output frequency of 110 mc. Now since the fundamental of this overtone crystal is one-seventh of 110 mc, or about 15.7 mc, we can change the mode over to the *5th overtone*, which will be approximately 15.7 x 5 = 78.5 mc. Coil L-4212 will have to be padded to resonate at this new frequency. This is accomplished by merely removing capacitor C-4248 (9 mmfd) and replacing with a disc or tubular of 25 mmfd. The coil will now resonate on 78.5 mc and the new *if* frequency will be the difference of 222.5 − 78.5 = 144 mc, which will work into a 144 mc receiving system very nicely. One other change in the receiving converter section is necessary and that is to change the 110 mc trap circuit labelled L-4219 and C-4245 to the new frequency of 78.5 mc. This is simple to do—merely bridge C-4245 with another capacitor of 150 mmfd. Lastly, after a 222.5 mc signal is received, touch up the slugs on the Preselector Z-4202 section for maximum signal. These slugs would be L-4218, L-4216 and L-4214 labelled "Factory Adjusted—Do Not Disturb." (Haven't you always been tempted to do something like this anyway?). This should complete the modifications.

Remember, the converter is a mixer with no rf amplifier stage. It should work well for the stronger signals—do not expect too much on very weak signal reception. Add a nuvistor, or perhaps a 416B 220 mc preamplifier for such work. Also keep in mind that the transmitter output stage on the TV-10 is a tripler with multiplied crystal ferquencies probably present to some extent. This is low power certainly, but aircraft line of sight is great and this range of frequencies is hot with such communications. Check carefully with a GDO or sensitive absorption type instruments for such unwanted emissions.

This little set will enable someone mildly interested in 220 mc to talk around town locally and it might even whet the interest to give 220 mc a real shake at some later date.

. . . W5AJG

Notes on the ARR-15 Receiver

Gordon Hopper W1MEG

The ARR-15 receiver, as received, will function by the addition of the correct voltages and actually requires no major conversion work.

Application of 28 VDC to the connector at the rear of the receiver will operate the dynamotor and it should be applied as follows:

Pins 3 and 20	jumpered
Pin 17	28 VDC
Pin 9	dc return

John Meshna, Inc. in Lynn, Mass., has power supplies which are ideal for the operation of this receiver. They are rated at 24 volts @ 4 amps and can be used on many types of surplus receivers.

In its original condition, the receiver is quite broad. Here is a modification which will select either a sharp or a broad filter: Remove the wire from terminal 2 of Z-122 and tape it out of the way. Remove the ground post.

Install a SPST bat handle switch in the vacated hole. Run a wire from terminal 6 of J-102 to one switch terminal and run a wire from the other switch terminal to terminal 2 of Z-122.

To make the receiver active when the receiver is off "0" when in MCW-CAL position, remove the wire from terminal 7 of J-102 and install SPST bat handle switch between this wire and terminal. Switch can be located below switch in above modification and labeled CAL. OFF-ON.

To make it possible to calibrate on frequencies whose last two digits are "0," jumper terminals 14 and 22 of J-110.

The addition of a Q5R may be desirable. Although I have the receiver operational, I have not yet had the chance to try one on it.

If desired, an AC supply for the B voltage (220 VDC at 80 ma) can be connected between pins 3 and 9 (ground) of the dynamotor connector after removing the dynamotor.

To reduce the current requirements of the 28 VDC power supply, it is recommended that the two locks on the front panel be loosened and that the tuning and band switching be accomplished manually.

The original technical manual for the ARR-15 receiver is identified as AN-30ARR15-3. Good luck on locating one.

New Life for the R-44/ARR-5 Receiver

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Introduction

Many amateurs and experimenters have purchased surplus R44/ARR-5 receivers in the belief that they were military versions of the Hallicrafters S-27. After finding out that the receiver has no power supply, lacks sensitivity, and has headset output only, they have stored the rather well-built equipment in the garage, and have gone on to other things.

Actually, the R44/ARR-5 *is* a military version of the well-known S-27, and can be made to operate as an S-27 with a very small amount of work. Basically, it is an AM-FM receiver, with one rf, oscillator, mixer, and two rf stages. Beyond this, there is a limiter and discriminator for FM reception; and an added *if* stage and diode detector for AM reception. Two stages of audio are provided.

Frequency coverage, in three ranges, is from 27 mc to 140 mc. A motor-driven band-scanning device is provided, as well as a fixed tuned bfo. Broad and sharp *if* adjustments are selectable by a front panel switch.

This frequency range covers 10 and 6 meters, a number of radio paging services, the lower frequency TV channels, all of the FM band, and the 110-140 mc aeronautical and

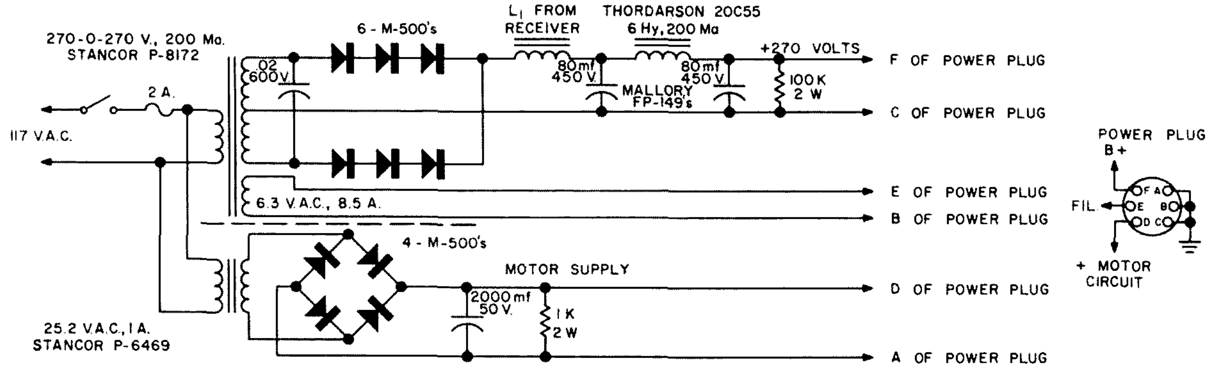

FIGURE 1

Circuit of power supply.

special communications bands. As a general coverage receiver from 28-140 mc it can hardly be surpassed, even though the design is more than 20 years old. It can be put into full service by providing a power supply and by making a few very simple circuit changes.

Power Supply

Operation of the R44/ARR-5 requires 6.3 volts at about 4 amps; 270 volts at about 135 ma; and, if the motor driven scanner is to be used, 24 volts dc at about 135 ma.

The circuit of a more than adequate power supply for this receiver is shown in Fig. 1. Choke input is used here to keep the B voltage low enough. It also reduces surges on the silicon rectifiers. The first choke (LI from receiver) is an original part of the R44/ARR-5, and is located at extreme left rear of the chassis. Remove both power leads from this and connect them together temporarily, then remove the choke from the receiver.

The .02 mfd capacitor across the high voltage secondary is to absorb rectifier switching transients. If omitted, this power supply may create interference at various multiples of 60 cycles up to at least 60 kc.

Ordinarily good construction is all that is required in the power supply, which is conventional in operation. If you do not want to use the motor-driven scanner, omit the motor supply circuit entirely.

Initial Testing

Once the power supply is complete, connect the receiver in accord with the plug diagram in the inset of Fig. 1, turn it on, and let it warm up for a few minutes. Connect any sort of antenna to the antenna input plug, and plug a headset into the phones jack. Check operation of all functions on all bands, and correct any troubles found.

Most likely troubles are cracked resistors and switches that don't work. Replace resistors found defective by those of like color code. Replace any of the laminated bakelite switches that don't work by good switches, preferably with moulded bakelite cases, so that a second generation of switch failures doesn't develop in a couple of years.

Improving Sensitivity

When this receiver is in operation, its sensitivity is low, and the signal-to-noise ratio is not very happy. This difficulty is due to the installation of a radiation preventer stage between the antenna and the first tuned rf stage. This is located in a small annex to the main tunner housing, at left rear. The top of this box carries the label "CAUTION, plate termi-

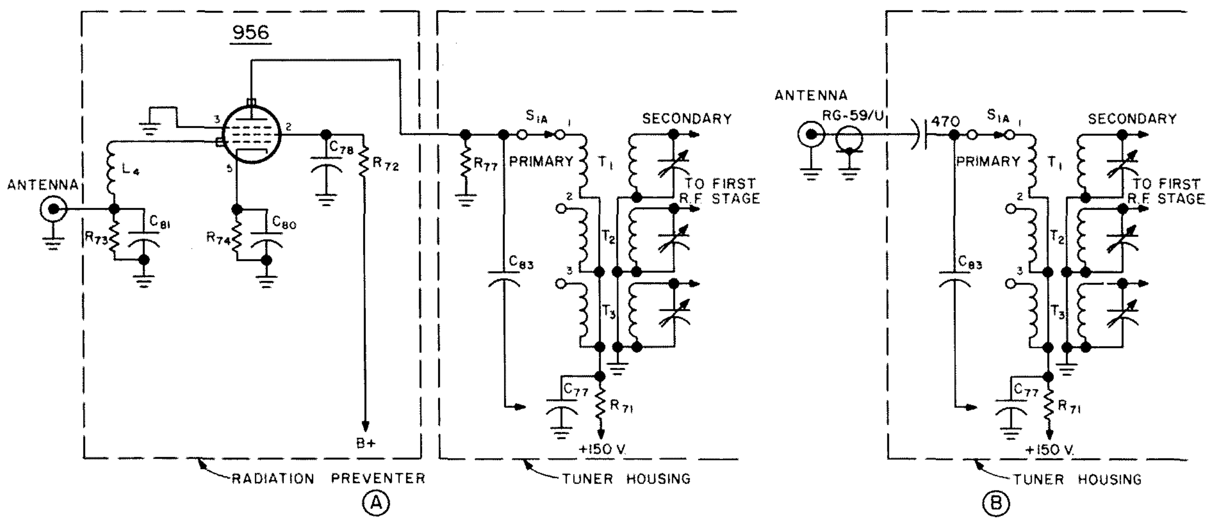

FIGURE 2

Front end revisions.

nal of tube inside projects into R-F stage." This stage is run at low B voltage so that it does not amplify, but unhappily it does contribute to the input noise.

The circuit of the front end of the R44/-ARR-5, as supplied, comprises section A of Fig. 2. To improve the receiver sensitivity, this stage is eliminated. Start by removing the 956 tube from the socket, then remove the small shield box, and finally disconnect the screen and filament supply leads from the connector that goes through the chassis. This will leave a clean circular hole in the back of the main tuner housing, and a clean elliptical hole through the chassis below it.

Remove R-77, a small resistor that connects from the plate lead of the 956 to ground. Center a UG-177/U plug hood over the round hole in the back of the tuner enclosure, mark the positions of the four holes, and drill clearance holes for 4-40 screws at the marked locations. Attach a piece of RG-59/U coaxial cable to the plug hood, leaving about 1½" of clear conductor on the inside. Bolt the plug hood in place, and mount two tie points on the holding screws inside the tuner shield. Connect the free end of the RG-59/U to the one farthest from the tunning capacitors. Connect a 470 mmfd capacitor between them, and connect the plate lead of the removed 956 to the tie point nearest the tuning capacitors. Pass the cable down through the elliptical hole in the chassis, and bring it out to either the front panel SO-239 plug marked ANTENNA or to any other termination that suits your convenience. Check operation, replace the cover on the tuner shield, and the front end changes are completed.

In most instances, this will more than double the usable sensitivity of the receiver, reducing the "front end hiss" considerably at the same time. Final circuit is shown in Fig. 2, B.

Output Modifications

As supplied to the government, the R44/-ARR-5 was designed for headphone and video output, and no provision was made for speaker operation. The original audio output circuit is shown in Fig. 3, A. All major components are mounted on terminal strips along the chassis skirts, and all are clearly numbered on the bakelite.

To convert the receiver for speaker operation, it is necessary to rip out the video output components and install an output transformer. To start this, cover the large hole at the left rear of the chassis (left when L1 was removed) with a metal plate, bolted in place. On the top of this, mount a small universal output transformer, such as a Stancor A-3877. Provide a grommet hole for the transformer leads. Under the chassis, behind the transformer, mount a tie point. To this connect the two leads removed from L1 previously, and the B+ lead of the output transformer. Connect the plate lead of the transformer to pin 3 of the 6V6 socket. Do not remove the other leads, or disturb the .33 meg resistor between pins 3 and 6 of this socket. This is the feedback resistor, R60 of Fig. 3.

Now find and remove R59, R70, R61, R69, R63 and C64. These are on the terminal strips near the tube socket, except for R63, which is a power resistor at about the middle of the terminal board. These components are best

(Turn to page 32)

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Another Surplus Find

Among the many thousands of items found on the surplus market, there is one unit that is often overlooked or rejected by the "surplus scavenger." This is the dynamotor set, not to be confused with the dynamotor alone.

The dynamotor set consists of a dynamotor, mounting bracket, chassis, various capacitors, a choke, filter assemblies, resistors, etc. The number and type of components will vary with each type of dynamotor set, but those components listed are generally common to all such sets. Taking the DY-76A/A1C-10 set as an example, the following components were removed and cataloged: one DY-76A dynamotor, (input 27.5 volts dc @ 7 amps, output 175 volts dc @ .6 amps), one filter reactor, (.2 henry @ .65 amps, tested at 1000 volts dc, resistance 7 ohms), two 100 mfd @ 300 wvdc electrolytics, two sealed pi type filters, (one rated at 50 volts dc @ 7.5 amps, and one at 250 volts dc @ 1 amp), and one 5½" x 7½" x 1½" chassis.

The 50 volt pi type filter may be used as an excellent filter for mobile operation of receivers, converters and low powered transmitters. The 250 volt filter may be used as an output filter for low voltage supplies or other such applications. The reactor, or choke, could easily find its way into power supplies, etc. Many applications can be found for the extremely well made, long lasting electrolytics. There is no need to mention the many uses of a strong aluminum chassis of the dimensions listed. In fact, the holes already punched in the chassis will serve most applications without the need of adding others. The holes punched for the mounting of the two electrolytics are perfect for tube sockets. Four permanently attached bolts hold the two chassis halves together quite neatly.

The 27.5 volt dynamotor can be operated from a 12 volt source with its output reduced approximately one half. It can also be operated from a 24 volt marine power source with no apparent decrease in output. If no such use is contemplated, the dynamotor can be converted into a 115 volt ac motor with little trouble and no expense.

The following instructions will enable the dynamotor to be used as an electric motor. First, remove the brushes from the motor end of the dynamotor assembly. The motor end is usually identified on the name plate, or can be found by tracing the yellow input lead. (The red lead is the positive high voltage output lead.) Remove the two field wires from the motor end and connect them in parallel with the generator field winding. Connect a 115 volt line cord across the field coils and generator brushes. If, after applying power, the motor does not run, reverse the motor field connections. There is a fifty-fifty chance of improperly connecting the motor field windings. As the dynamotor shafts are not long enough to attach a pully, etc., it will be necessary to drill and tap the shafts to attach an extension. The motor that you now have may not deliver as much torque as a standard, commercial motor, but it may be used in many applications. Its low cost more than overcomes any shortcomings it may have. One of these conversions is used by the author to power a small grinding wheel, and another is used to power a blower for cooling of electronic equipment.

The dynamotor sets are found at most surplus dealers and their low cost makes them one of the best buys on the surplus market. Better hurry and get yours before the price goes up!

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7*	14	14	14	14
ARGENTINA	14	14	7*	7	7	7	14	14	14	14	21	21
AUSTRALIA	14	14*	14	7	7	7	7	7	7	7	14	14
CANAL ZONE	21	14	14	7	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	14	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	14	14	7	7	7	7*	14	14	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7*	7	7	14	14
MEXICO	14	14	7*	7	7	7	14	14	14	14	14	14
PHILIPPINES	14	14	7*	7	7	7	7*	14	14	7*	7*	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	14	7
U. S. S. R.	14	7*	7	7	7	7*	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7*	14	14	14	14
ARGENTINA	14	14	14	7	7	7	14	14	14	14	14*	21
AUSTRALIA	14	14*	14	14	14	7	7	7	7	7	14	14
CANAL ZONE	21	14	14	14	7	7	14	14	14	14	14	21
ENGLAND	14	7	7	7	7	7	14	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	14	7	7	7	7*	14	14	14	14	14
JAPAN	14	14	14	14	7	7	7	7*	7	7	14	14
MEXICO	14	14	7*	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	7	7	7	14	14	7*	7*	14
PUERTO RICO	14*	14	14	7	7	7	14	14	14	14	14	14*
SOUTH AFRICA	7	7	7	7	7	7	14	14	14	14	14	7
U. S. S. R.	14	7*	7	7	7	7	7*	14	14	14	14	14

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	14	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	7*	7	7	7	14	14	14	14	21
AUSTRALIA	14*	21	21	14	14	7*	7	7	7	7	14	14
CANAL ZONE	14*	14	14	14	7*	7	7	14	14	14	14	14
ENGLAND	14	7	7	7	7	7	7	14	14	14	14	14
HAWAII	14	14	14*	14	14	7*	7	7	14	14	14	14
INDIA	14	14	14	14	7	7	7	7*	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7*	7*	14	14
MEXICO	14	14	14	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7	7	7	14	7*	7*	14
PUERTO RICO	14	14*	14	7	7	7	7*	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	7*	14	14	14	14	7
U. S. S. R.	14	14	14	7*	7	7	7	7*	7*	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

* Means next higher frequency may be useful. . .

Good: 2-8, 14-17, 22-24

Fair: 1, 9-13, 22-21, 25, 28-30

Poor: 18-19, 26-27

Es: 4-8, 13-18

(High MUF and/or freak conditions)

J. H. Nelson

(Receiver from page 28)

removed by clipping the leads. Because of their age, few of them are worth salvaging.

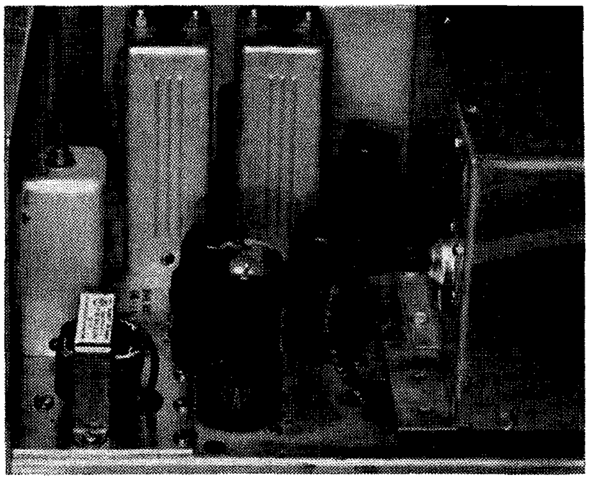
Now, from pin 5 (grid) of the 6V6 to ground connect a .1 meg resistor, of ½ watt or larger. From pin 8 of the same tube (cathode) connect a 330-ohm 2 watt resistor to ground, and shunt it with a 25 mfd, 25 volt electrolytic capacitor, connected with positive to socket.

Lastly, connect the secondary circuit of the output transformer to the speaker terminals and the phone jack, as in Fig. 3, B. With this connection, the speaker is silent when the headset is plugged in. The load that is switched in when the speaker is disconnected is not critical, any value from 5 to 22 ohms will work well, but its omission will insure that the audio circuit will oscillate powerfully.

When this work is completed and tested, the conversion of the receiver to ordinary use is completed. Appearance of the left rear portion of the chassis, where the changes have been made, is shown in the photo. If, after everything tests OK, you wish to go over the underchassis wiring, eliminating unnecessary wires and sections of terminal board, appearance of the equipment will be improved slightly, but no changes will occur in the performance.

Automatic Scanning

As previously mentioned, this receiver is equipped with an automatic scanning device, which requires an input of 24 volts dc. The range of the scan is adjustable from the front panel, by means of a pair of switch cams under the hinged cover. The on-off switch for the automatic scan is near top center of the panel. The speed of the scan is adjustable by means of a 250 ohm wirewound rheostat at rear center of chassis. This runs quite hot on continuous scan, as does the motor. The magnetic clutch, which connects the motor drive to the tuning shaft is a rugged device, which will last almost forever. The motor, in contrast, has a nominal life of about 1,000 hours, of which a considerable portion may have been used up in military service.



Rear chassis view of converted R44/ARR-5.

Performance of this receiver, after conversion, is rather surprisingly good and as consistent as band conditions permit. Tuning gear train operates very smoothly, permitting use of the receiver on the sometimes crowded 10 and 6 meter ham bands. The power supply has enough spare capacity to carry most if not all of the adjuncts that a fertile mind will find interesting with this type of receiver.

. . . Ives

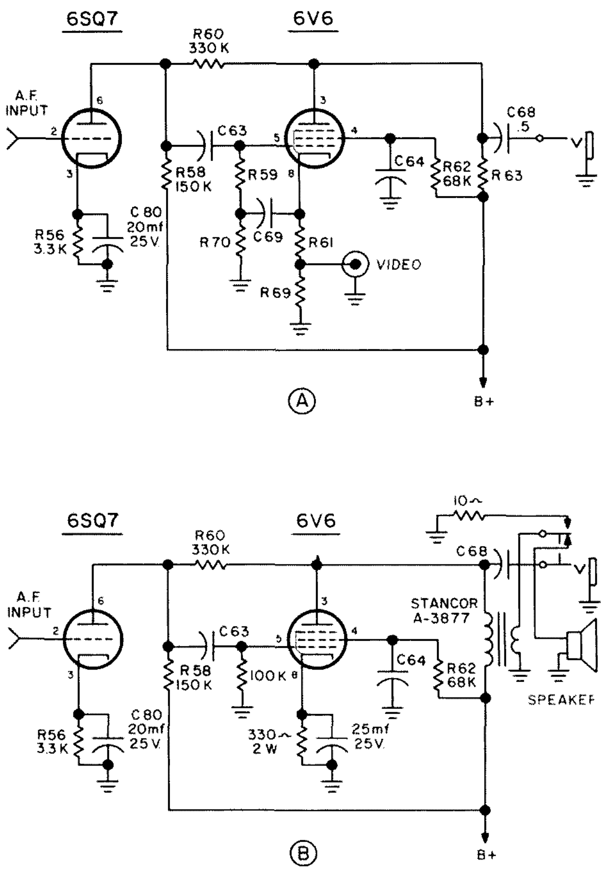


FIGURE 3

Receiver output circuit.

Really High Gain

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Gain in an audio amplifier is something you seldom worry about unless you don't have enough—but if you're planning a new portable or mobile rig, you might like either of the two circuits shown here. Both produce voltage gains in excess of 1,000, with an absolute minimum of components.

Using these circuits, a ceramic or dynamic microphone will give you plenty of punch for full modulation—without the worries about audio quality which frequently accompany the use of a carbon mike.

The lead-off circuit, shown in Fig. 1, is a variant on the cascode. The cascode is probably better known as a VHF rf amplifier than as a high-gain audio circuit—but this version gives voltage gain ranging from 1,000 to 2,000, depending on the type of tube used.

Since three triode sections are necessary for best action, this circuit is a natural for Compactrons such as the 6D10 or 6C10. Component values shown are suitable for either, as well as for the three halves of 12AX7, 12AT7, or 12AU7.

Here's how it works. In a normal cascode circuit, the stage gain is actually (very close to) the product of the transconductance of the *input* section multiplied by the load impedance seen by the *output* section. In this version, the load impedance is 4.7 megohms. To keep current flow in the input stage, thus keeping transconductance high, the output stage is shunted by a 22K ohm resistor.

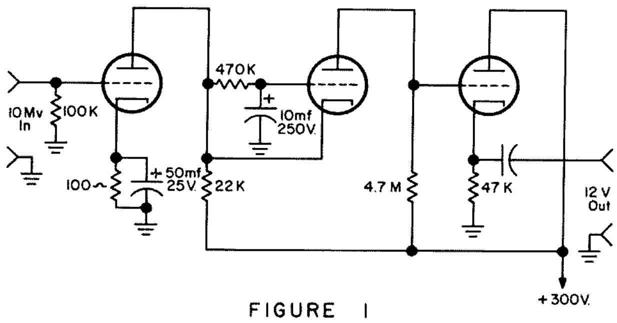


FIGURE 1

Since the input impedance of the output stage is low (usually under 500 ohms), all the signal goes into the output stage. Thus, the stage gain equals the transconductance of the normally functioning input stage times the extremely high plate load resistance in the "output", giving a range of gain between 1,000 and 2,000.

The cathode follower actually used as the output is necessary because otherwise the high output impedance would cause problems above 1500 cps. As shown, response is good throughout the "communication" range up past 3,000 cps, then falls off rather sharply.

The only tricky point to watch in this circuit is to be certain that no heater wires or rf-carrying leads come anywhere near the plate end of the 4.7-meg resistor or the lead connected to the grid of the cathode follower.

While the three triode sections connected as normal amplifiers would provide more actual gain, such connections would also require 3 additional resistors and 3 additional capacitors, as well as introducing phase shifts and attendant possibilities of audio feedback.

But if you're searching for something closer to the ultimate in the "something-for-nothing" department, sneak a peek at Fig. 2. This "starved" amplifier uses only two tubes, four resistors, a single capacitor, and one transformer, to fully modulate a 5 watt transmitter with the output of a ceramic mike!

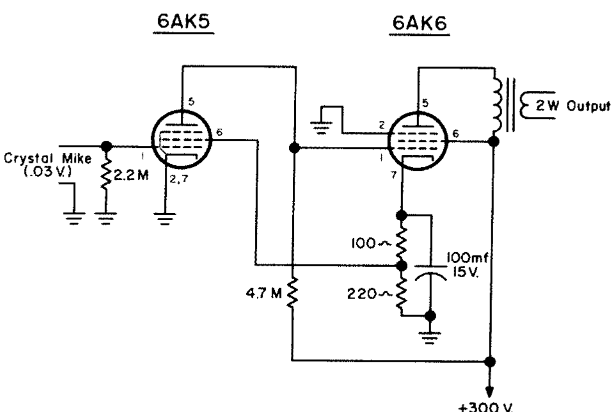


FIGURE 2

(Turn to page 90)

Smaltz for Semiconductors

Robert A. Kidder

After about the forty-seventh time that I put the finishing touches on some exotic piece of semiconductorized gear and reached out to apply the juice, only to find that another battery pack had gone to its reward, I finally decided to end it all. Not with the trusty old .44, however, but by hitting the books and engaging in a bit of judicious brain-picking among certain of my cohorts. Herewith follows the results of this research: a treatise on the derivation of low voltage direct current in any reasonable quantity from the ac line.

The biggest difference between vacuum tube plate supplies and transistor supplies is impedance. Tube circuits in general are high impedance affairs and are therefore low current loads. Transistors, on the other hand, are inherently low impedance devices and are heavy loads for power supplies. A typical tube circuit might draw 15 milliamps at 150 volts, or 2.25 volt-amperes, while a similar circuit in transistors might require 15 milliamps at 15 volts, which is also 2.25 volt-amperes. This makes the transistor supply a big, hairy monster, when considered on the basis of the voltage to current ratio. This means that the transistor supply must have very low impedances associated with it. Its output impedance especially must be as low as possible. With this much having been stated, let us now have at these semiconductor feed-bags.

The first thing to consider is the rectifier, because this will have a direct bearing on virtually every other component in the supply. Figure 1 shows a simple, inexpensive, half-wave circuit, which is suitable for light loads (25 milliamps or less). The main reason that heavier current drains from this circuit are not advisable is that the half-wave rectifier is quite inefficient. It delivers to the load less than 50% of the available current. Another point to consider is that the 60 cycle ripple in the output of a half-wave rectifier is five times harder to filter than the 120 cycle full-wave buzz. This means that hum will increase at a much faster rate with an increasing load than it would in the case of a full-wave circuit. A factor stemming from this is that voltage regulation is inherently poor in a half-wave supply. These faults notwithstanding, half-wave circuitry can be used in compact, low current supplies, especially if very small ripple is not a requirement.

Figure 2 illustrates two basic types of full-wave rectifiers. 2A is the conventional center-tapped configuration which is commonly used in vacuum tube plate supplies. In transistor supplies, however, this circuit is not employed as extensively as in Figure 2B, the full-wave bridge. The full-wave center-tap circuit can be used for loads of any magnitude, but it delivers only about 70% of the available current, and it requires a transformer with a center-tapped secondary. Digging up a center-tapped transformer that will produce 35 to 40 volts of dc could be quite a sporting proposition.

Since suitable rectifiers can be had at very reasonable prices, the full-wave bridge of Figure 2B offers distinct advantages. One is the fact that it will pass 90% of the available current, which makes it the most efficient of the rectifiers under discussion. In transistor power supplies, it is by far the most commonly used rectifier circuit.

The characteristics of each type of rectifier should be kept in mind when choosing components. A diode being used in a half-wave circuit should have a current rating of at least twice the maximum anticipated load current, and a peak inverse voltage rating equal to 2.8 times the RNS voltage of the transformer secondary (this PIV rating criterion assumes the use of a capacitor-input filter, which is the usual case in transistor supplies). Rectifying elements in

a center-tap circuit should have a current rating at least equal to the load current, and the PIV of each diode will be 1.4 times the RMS voltage of the transformer's entire secondary. The minimum current rating for each of the four diodes in a full-wave bridge is equal to one half of the maximum anticipated load current, while the minimum PIV rating is the same as for a center-tap circuit.

Usually the power transformer for a transistor supply is a small filament transformer. These are available in quite a number of secondary voltages, ranging from 2.5 to 26.5 volts, with higher voltages obtainable in other types of power transformers. Other kinds of transformers, such as audio output or interstage types, can be used also, especially in low current supplies, but the word here is "Caution".

(Turn to page 38)

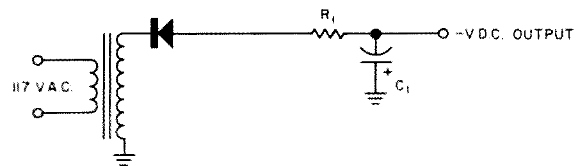


FIGURE 1

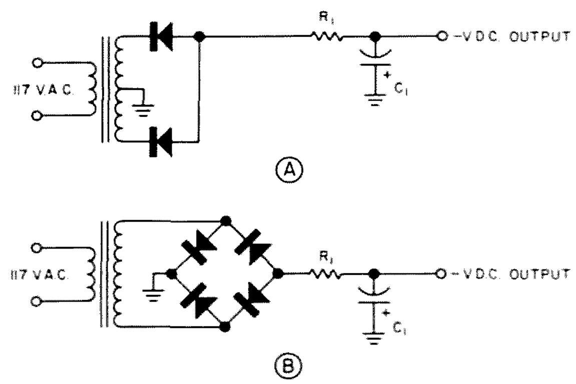


FIGURE 2

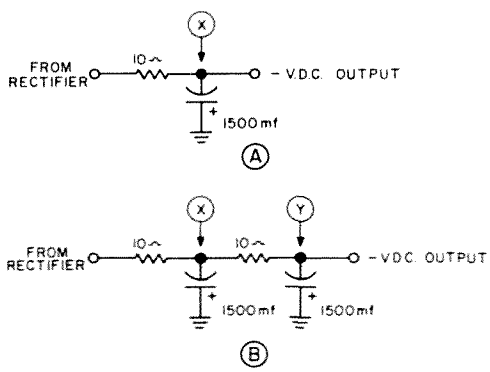


FIGURE 3

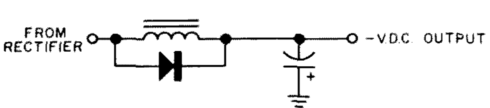


FIGURE 4

(Semiconductors from page 35)

In picking a transformer, you should keep in mind that the input capacitor of the filter will charge up to the peak voltage of the secondary. The peak voltage is equal to 1.4 times the RMS voltage at which the secondary is rated. Thus, a 6.3 volt filament transformer will develop nearly nine volts across the filter capacitor, which, if it is large enough, will maintain that voltage level even in the teeth of a moderately heavy load.

Another factor to consider in choosing a transformer is the rectifying circuit that it will be looking into, because this will affect the current rating of the secondary. The efficiency figures given previously for the various types of rectifier circuits refer to the percentage of a transformer's secondary current capability which can be drawn by the load without overworking the transformer. They are less an indication of how big a wagon a supply is than of how big a horse the transformer has to be in order to move it. If a half-wave rectifier is to be used, the current rating of the secondary should be equal to at least twice the maximum expected load current. In the case of a center-tap circuit, the secondary current capability should exceed the load current by at least 40%. For a full-wave bridge, the current rating of the secondary should at least equal the heaviest anticipated load current.

Now let's take a look at filter circuits. The first component usually encountered is the surge limiting resistor, R1, which is added to protect the rectifier. The reason for this is that when the supply is first turned on, the uncharged filter capacitor is a dead short, and the instantaneous current flow is very high. Without RI in the circuit, this surge would be limited only by the forward resistance of the rectifier in series with the resistance of the wire in the transformer secondary. The peak surge current could be 20 amps or more, which is enough to wipe out instantly many low current diodes. The value of R1 is picked to keep the maximum possible current flow (effectively the same as a short from the rectifier output to ground with the peak secondary voltage present) less than the one-cycle surge rating of the rectifying element. Typical values for R1 will fall between 5 ohms and 50 ohms, in general. The surge limiting resistor is not always required with medium to heavy duty rectifiers (those rated at 500 milliamps or higher). A quick look at the Condensed Rectifier Specifications sheet in the fourth edition of the G. E. Transistor Manual seems to indicate that the one-cycle surge rating of any given (G. E.) rectifier is at least 20 times greater than its continuous current rating.

The next component is the filter capacitor. For most light and medium load applications, the B. F. C. (Brute Force Capacitance) approach is usually adequate. This consists of hunting up the biggest, hairiest, electrolytic capacitor you can find and placing it across the output of the supply, such as with CI in Figures 1 and 2. In general, 250 microfarads should be considered the practicable minimum for loads up to 20 or 25 milliamps. Where loads approach one amp, the filter capacitor may have a value of five thousand microfarads or more, although with loads of this magnitude it's better practice to use a multi-section filter and electronic regulation.

The voltage rating of the filter capacitor should be taken into account, too. It goes without saying that an electrolytic must never be exposed to voltages greater than its rated working level, nor should they be wired up in reverse polarity. They've been known to come apart with explosive force under either condition. The voltage rating of an electrolytic should always exceed the actual voltage present in its working circuit by a small margin, at least 20%, but it can go as high as 100% or more. In any event, if the voltage rating is greater than the working voltage by a large amount, three or four times, for instance, the capacitor may not "form" properly. This condition manifests itself as a loss of rated capacitance, and as a result, the filtering action can be reduced greatly. In choosing a filter capacitor, then, keep its voltage rating higher than, but reasonably close to, the peak voltage of the transformer secondary.

In a previous paragraph, multi-section filters were mentioned. Let us examine them more closely forthwith. Referring now to Figure 3A, suppose the load is such that there is 100 millivolts of ripple at point "X". Assume further that this amount of ripple is intolerable for the desired application, but that 10 millivolts would be acceptable. In order to reduce the hum voltage by a factor of ten, several things can be done. You could increase the value of CI ten times. Fifteen thousand microfarad electrolytics are available, and they're well within the means of the average working millionaire. A more practicable, and certainly less expensive, solution is to add a second filter section, as in Figure 3B. Since the reactance of a 1500 microfarad capacitor is slightly less than one ohm at 120 CPS (assuming full-wave rectification), the 100 millivolts of ripple pres-

ent at point "X" will see an effective resistance of 11 ohms to ground: the ten ohms of R2 in series with the one ohm reactance of C2. This is a simple voltage divider. Therefore, the ripple to be found at point "Y" will be 1/11 of the ripple at point "X", or just over 9 millivolts, with the remaining ninety-odd millivolts having been dropped across R2. The DC voltage at point "X" will see only R2 in series with the load resistance, with C2 looking like an open circuit. Ripple could be further reduced by increasing the value of R2, but watch out for the DC voltage drop across it. With a one amp load on the circuit of Figure 3B, the DC drop across R2 would be 10 volts. The writer hastens to add that the values given for R1 and R2 in Figure 3 are obviously not advisable in normal practice for a one amp filter circuit.

Chokes are not usually used as filter elements in semiconductor supplies. One of the reasons for this is the fact that the DC resistance is fairly high, as much as two or three hundred ohms. Another reason is that most of the small filament transformers commonly used in transistor supplies can deliver one amp without even trying; if you happen to have a one amp choke lying about, it could be used to far better advantage in your kilowatt vitamin pill. Still other factors to consider are large physical size, magnetic radiation, and dangerously high (for transistors) inductive kickback voltage when the supply is turned off.

It is not the writer's intention to condemn the use of chokes in semiconductor supplies, however. They can be utilized, sometimes to good advantage, for loads up to a quarter amp or so, if the overall size of the supply is not a factor. The first consideration is that the choke will tend to hold the output voltage at the RMS voltage of the transformer secondary, thereby affording improved regulation. The choke should be positioned with its core at right angles to the transformer core in order to minimize hum radiation, although this is a lesser problem with semiconductor devices than with vacuum tubes, owing to the inherently low impedances of transistors. The inductive kickback can be neutralized by connecting a diode across the choke, as shown in Figure 4. The polarity of the diode should be such that it does not conduct when the supply is in use; it acts to short out the high voltage spike generated by the collapsing magnetic field of the inductor when the supply is turned off, or otherwise suddenly interrupted. One other thing: make sure the capacitor and choke combination that you use is not resonant at either 60 or 120 cps, otherwise you may find that you have raw, wild ac of startling amplitude instead of clean, smooth dc. If you do decide to use a choke, put it ahead of the filter capacitor and omit the surge limiting resistor.

This half of the article has detailed the process of converting the ac line power to low voltage dc which may be used "as is" for many transistor circuits. In the second half we shall examine various ways to regulate the output voltage of these supplies. We'll also look into methods of varying the voltage output. Be sure to tune in again next month.

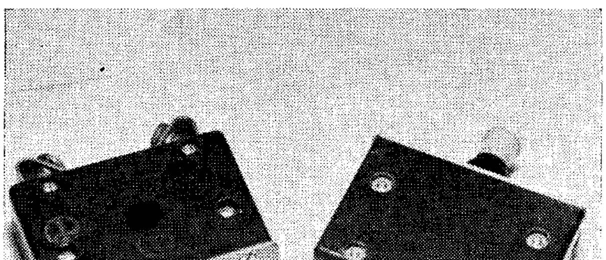
. . .Kidder

Surplus Circuit Breakers

Roy Pafenberg W4WKM

Large quanities of aircraft circuit breakers are available on the surplus market in a wide range of current values. Typical of those available are the 10 ampere units shown in the photograph. Since the prices are so ridiculously low, you have probably passed them up as unusable for ac and low-voltage dc applications. Such is not the case. These low-cost breakers are usable in most amateur applications.

Before we go into specific applications, a description of the most commonly available units is in order. These breakers, shown in the photograph, measure approximately ¾″ wide by 2 3/16″ high and extend about 2″ behind the panel. Mounting is accomplished by two 6-32 screws on 1 13/16″ centers. A clearance hole of ½″ diameter is required for the actua-



Surplus aircraft circuit breakers, such as these 10 ampere units, have wide amateur application.

tor knob bushing. Terminals consist of metal tabs equipped with 8-32 machine screws. The breaker is closed by pushing in on the front button and opened by pulling it out. In the event the breaker trips, reset is accomplished by simply closing the breaker again.

These breakers are of the thermal trip type so that trip is a function of both percentage and duration of overload. While these units are specifically rated at 120 volts, 400 cycle ac and 30 volts dc, they may be (and have been) successfully used at 120 volts, 60 cycle ac. Current ratings of the standard types range from 5 to 50 amperes and low amperage units are available in the range of 1 to 4 amperes.

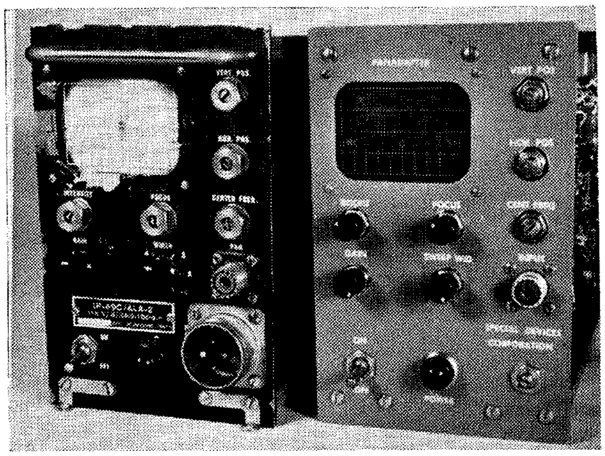
These surplus thermal-trip circuit breakers will carry 100% of their rated current indefinitely and will trip at 125% of their rated current. Trip time at 200% overload ranges, for the various types, from 8 to 25 seconds. Trip time for greater overloads is proportionally shorter. Current interruption capacity varies with voltage and frequency but, in any event, is on the order of several thousand amperes.

Designed to meet military specification requirements, these breakers are *relatively* immune to vibration, shock and temperature variation. Give these low cost, high quality breakers a try in your next construction project. They provide a simple answer to mobile and home station power switching and protection requirements.

. . . W4WKM

Converting the IP-69 / ALA-2 Panoramic Indicator

William Parker W8DMR
2738 Floribunda Drive
Columbus 9, Ohio

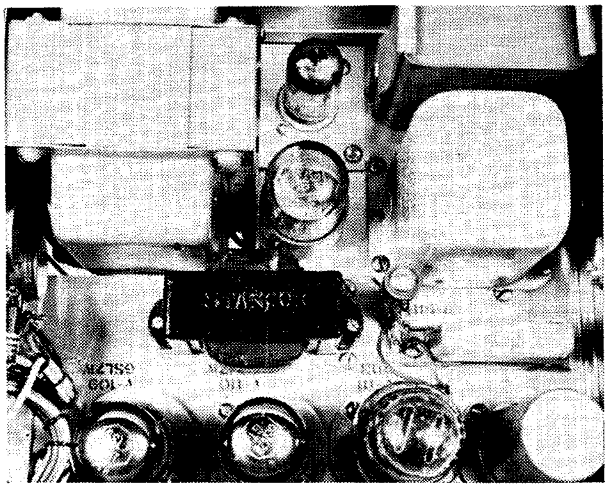


Unit as purchased left, and after conversion right. The power connector hole was plugged with an aluminum disk and liquid aluminum paste.

The budget-restricted ham can convert the surplus ALA-2 into a satisfactory panadaptor. Before diving into the conversion, it is best, especially if one does not have understanding of the operation of a panadaptor, to review the functional operation of such a unit. (See block diagram, Fig. 2.) Briefly, the panadaptor is an electronic device that displays on the face of a cathode-ray tube a portion of the radio frequency spectrum. Individual vertical "pips" are panoramically displayed across the horizontal axis of the CRT face. See Fig. 1. An incoming signal (from a receiver) is fed into the broad-band rf amplifier, than into a mixer, the *if* amplifier, and the detector, just as in any conventional superheterodyne receiver. However, the local oscillator voltage supplied to the mixer must vary sufficiently in *frequency* so that it can cover the frequency width carried by the rf amplifier. This is accomplished by the reactance tube which varies the oscillator frequency over the proper range. The reactance tube is controlled in turn by the sawtooth generator so that the frequency variation of the oscillator is kept in synchronism with the horizontal deflection. As this deflection occurs, the oscillator beats progressively and periodically with one signal after another to produce an intermediate frequency of 6.5 megacycles. Thus one signal after another is periodically amplified by the *if* amplifiers which are resonant to 6.5 megacycles. Each signal as a signal of the intermediate frequency, in its own order is subsequently rectified by the detector.

The output of the detector is fed to the vertical amplifier and the output of the latter is fed to the vertical deflection plates of the cathode-ray tube.

A signal voltage from the vertical and horizontal amplifiers is used to excite the blanking and intensifier circuit. The output of this circuit is connected to the control grid of the cathode-ray tube and accomplishes two things.



It blanks out the retrace and intensifies the trace whenever a signal deflection takes place.

Conversion Details

The panadaptor power supply is designed for 380-1000 cycles. It will be necessary to replace the power transformer with a 60 cycle oscilloscope power transformer. The one used by the author was a replacement transformer for a Heath 0-11 oscilloscope. See modified schematic diagram. Most transformers do not provide for a 1B3 filament winding. The transformer used in this conversion used a IV3 high voltage rectifier. The author also wished to remove the power connector, name tag, fuse holder, handle and mounting fasteners from the front panel to give the unit a commercial appearance.

Each individual will have ideas that suit his own needs or that utilizes a particular "junk box" part that he wishes to make use of in the conversion of the panadaptor. The steps outlined in the article will serve as a guide to help get started.

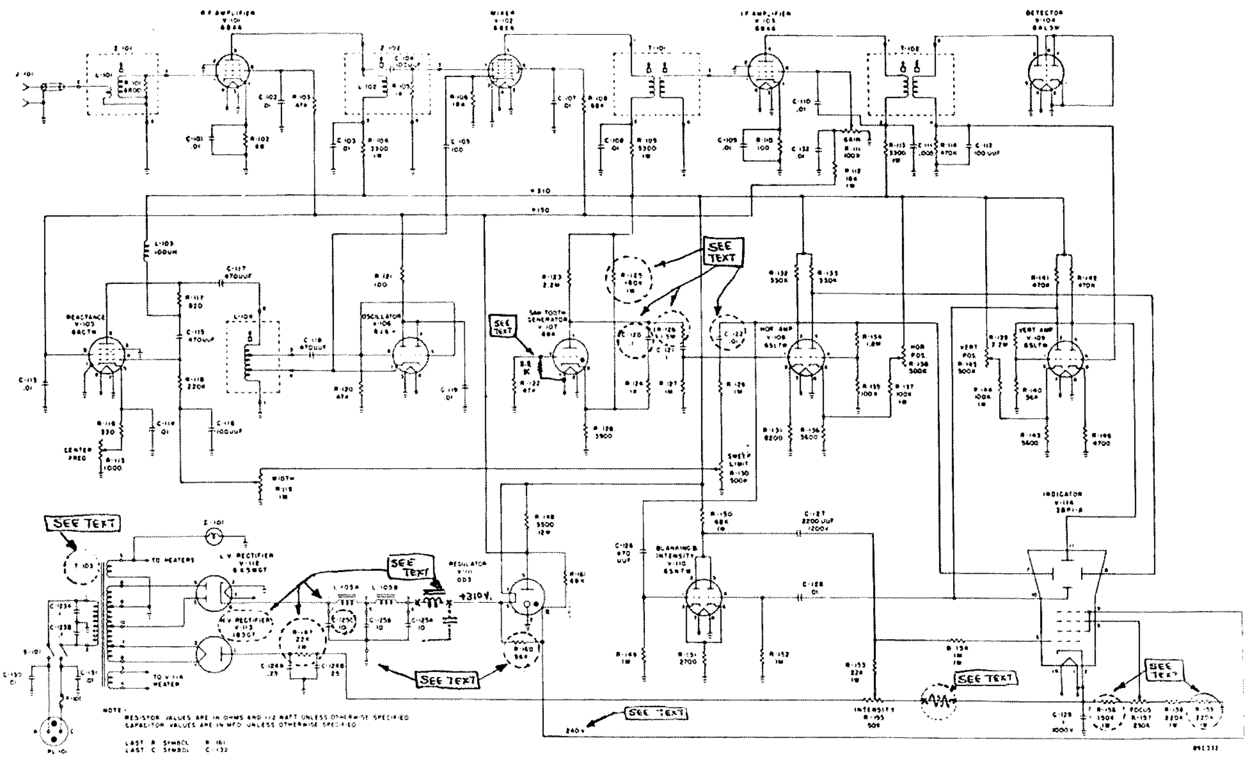
A brief reason will be given for the part that was changed or replaced to help in the understanding of the conversion. This will be particularly helpful in the advent of trouble and also help you to determine if the change is unnecessary or fits your particular application.

The unit that was converted by the author was very clearly marked with respect to component identification. Reference to a resistor for example, R125, upon inspection of the unit, is very easy to locate. Hallicrafters did an admirable job when they built this unit for the Air Force.

Conversion Steps

Step 1. Replace power transformer with 60 cycle version. Remove 400 cycle transformer. See schematic diagram for transformer details. The author, in order to mount the transformer he had available, cut a hole in the chassis and mounted the transformer on two small angle brackets.

Step 2. Replace the 1B3 with a 1V2 tube. This is only necessary if the replacement transformer does not have a 1.25 volt high voltage rectifier filament winding. Most inexpensive oscilloscope transformers have a 0.625



filament winding, and will only operate a IV2 satisfactorily.

Step 3. Replace the following resistors in the high voltage power supply section and accompanying voltage divider circuit. (Note: Throughout the conversion, many of the resistors removed may be used again in the conversion. Therefore treat the leads with respect.) In order to provide the 800 to 1000 volts needed for the high voltage with the ripple component low enough, and still use the high voltage filter capacitors C124A and C124B, it is necessary to:

1. Increase the value of R147 from 22K to 220K 1 watt.

2. Increase the value of the high-voltage divider network to limit the current drain. Remove R159 220K 1 w. Replace with 1.0 meg 1 watt. Remove R147 22K 1 w. Replace with 220 K (use R159). Remove 156 150K 1w. Replace with 680 K 1 watt. Remove yellow wire from R155. Add in series a 22K 1 watt (use R147) between yellow wire and connection of Intensity control. Remove R160 56K ½ w. Replace with 150K (use R156). This improves the astigmatism of the electron beam.

Step 4. In the author's unit, it was found necessary to add a small 8 henry—70 to 100 milliamp choke in series with B-plus. In addi-

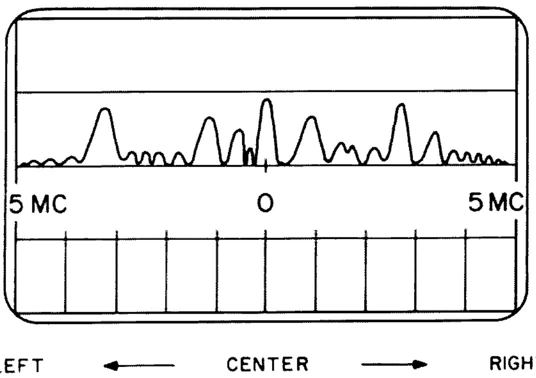


FIGURE 1

Block diagram less power supply.

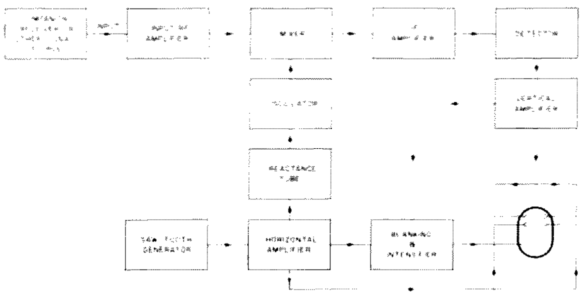


FIGURE 2

Typical display on screen of panadaptor.

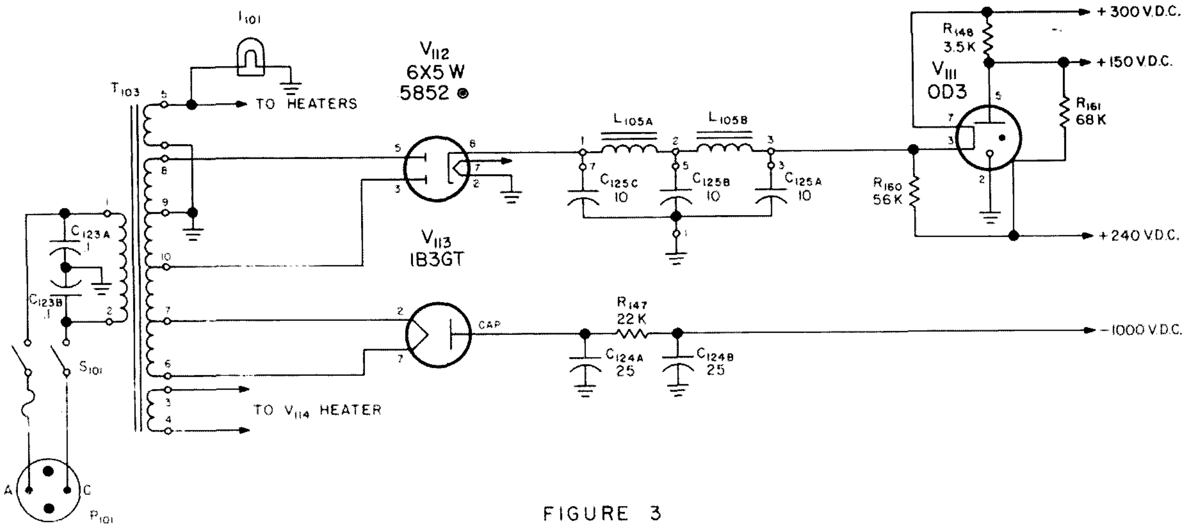


FIGURE 3

Power supply before any changes are made.

tion, B-plus was found to be 350 volts, and needed to be reduced. As opposed to using a series-dropping resistor, choke input to the filter section was chosen. See sketch for this arrangement.

Step 5. The sawtooth generator frequency was original 35 cps. This does not lend itself to 60 cycle operation, because of the beat of the 60 and 120 cycle power supply ripple. Locking of the 884 sawtooth generator to the 60 cycle power line was chosen. The other components in this circuit were changed to improve linearity, amplitude and wave shape. Stability was improved by returning R125 to plus 150 also. It may be necessary to vary R125 from the value used in this article. Capacitor C121 was found to have leakage (0.1 mfd. 400 v) and was producing drift in the horizontal axis.

Connect a 2.2 K ½ watt resistor from pin 5 to pin 7 of the 884 sawtooth generator, v 107, This locks the oscillator to line frequency. Remove C120 0.1 mfd. Replace with 0.2 mfd. 400 volts. Remove C122 .01 mfd. Replace with 0.1 mfd. (use C120). Added care must be exercised in the next several changes if no errors are to occur. Remove R125 180K 1 watt (a 43K resistor eventually). Remove jumper form top of R113 to top of post where R125 was just removed. A small mirror used to view under the terminal strip will show a red wire (the wire is B-plus that supplies the 310 volt to R113, R109, and R104). Heat the terminal from top side of the terminal board, using a pic to pull the red wire loose from the underside of the terminal board. If necessary, lengthen the red wire so it now may be connected to the top of R113 and R109. Connect a jumper from the top of R121 (next to R109) to the top of the post where R125 used to be. Connect a 43K 1 watt resistor where R125 used to be. Remove R126 1.5 meg ½ watt. Replace with 1.0 meg ½ watt.

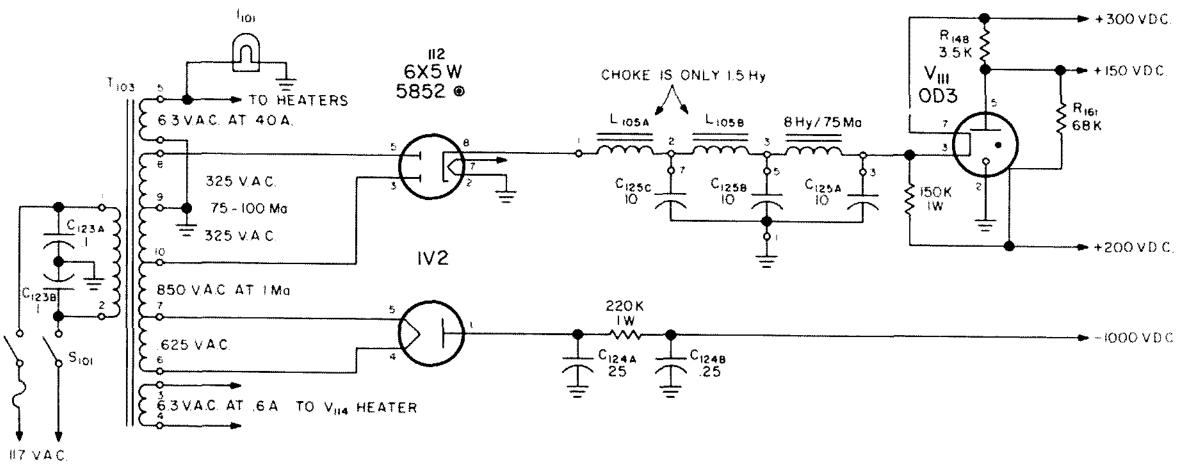


FIGURE 4

Power supply after changes are made. Note T-103 has been replaced with 60 cycle unit (see text).

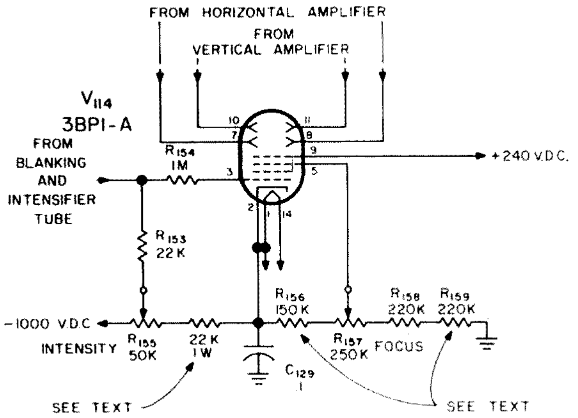


FIGURE 5

Only three resistor changes are required to high voltage divider network.

Step 6. Depending on just what vintage of ALA-2 that you have, you will note some production runs have the fuse holder on the front panel, some have fuse holders mounted inside the unit. The unit described in this article had internal fuse holder clips. They were removed, a fuse holder installed in the rear of the unit, and the ac power cord inserted through a grommet just below the fuse holder. The case was then modified to allow the fuse holder and the power cord with molded plug to freely allow casing and uncasing.

Step 7. Having made the necessary preliminary conversion steps, it is advisable to see if the unit will operate on 60 cycles satisfactorily. The *intensity* should control the brightness of the trace; the *focus* should be able to focus the trace. The *vertical* and *horizontal* controls should be able to position the trace. Before attempting any additional changes, the beam must be operating correctly. Observe if the VR-150 is glowing. Next measure the plus 300 volts dc. Measure the plus 150 volts dc. Do not proceed until these voltages are correct. Carefully measure the CRT high voltage. This should be approximately a negative 850 to 1100 volts. If the high voltage is accidentally shorted to ground, the 1V2 rectifier tube will most probably be permanently damaged. With a low voltage B-plus of 300 volts, the measured current was found to be 75 ma.

Step 8. To test the rf section, connect or couple either an rf signal generator or a grid-dip meter to the *input* connector. Set the *gain, sweep limit,* and *sweep width* controls full clockwise position. As the signal generator is tuned from 25 to 35 mcs, a "pip" should roll across the face of CRT. It may be necessary to reduce the level of the signal to keep the pip on the face of the CRT. Set the signal generator to 30 mcs and adjust the *center freq.* control to position the pip to the center of the screen. If this can be accomplished, then the unit is operating as it was intended to operate.

Applications

To display the VHF or UHF ham bands, a narrow-band panadaptor that is very adequate on the lower frequencies (below 10 meters) will not be adequate for a band like 420-450 mcs. Once the user realizes that the need to tune back-and-forth across several megacycles of VHF-UHF band is no longer necessary, the broad-band panadaptor soon becomes a valued piece of equipment to the ham shack.

After a CQ is called, one merely looks at the display on the panadaptor sees a "pip" rise on the screen, and tunes to that frequency to find out if that station is returning to his "CQ."

Often "CQ's" are missed because they are not observed soon enough. While reading the the mail, one may monitor the rest of the band, ready to take action when a station "appears."

This unit is used with broad band converters having an *if* range of either 26 to 30mcs or 30 to 34mcs. It could be modified for VHF converters with different *if* ranges. A check of the entire band may be made any time, because the signal fed to the panadaptor is from the broad-band crystal controlled VHF-UHF converter. In the case of panadaptors used normally for low frequency operation, the signal is fed to the panadaptor from the *if* output of the receiver and only about 250 kc can be observed. As the receiver is tuned, the signals roll by. Only those signals tuned in the pass-band can be observed.

. . . W8DMR

Hams in the News

NEW YORK. Charles Green, of Clayton, N. J. got an emergency call from Recife, Brazil for a special drug for leukemia. In a short while Green had cut through a lot of red tape and the drug was on the way by air to Brazil.

HOUSTON. Rancher P. C. Coates suffered a heart attack and called for help on his ham rig. Two hams, 500 miles away in Houston, heard the call and gave instructions from a local doctor over the air and got an ambulance to the home. Coates is recovering.

Using the Telechrome 1462-A1 on 220

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The Telechrome Model 1462-A1 transmitter is a minature unit capable of supplying at least 50 watts of rf power into a 50 ohm load, over the telemetry frequency range from 215 mc to 235 mc. The modulation is FM/FM and the deviation sensitivity is such that a 2 volt peak voltage will produce a swing of ±125 kc. The transmitter is self-contained, except for the necessary power supply. A filter box, including filters for each power input lead, is included to minimize rf leakage from the input power leads.

The model 1462-A1 is readily adaptable to standard rack-panel mounting and an opening in the unit admits power, cooling air and the modulating signals, with an air seal to prevent air leakage.

Although this unit is capable of FM modulation as is, the application at this station was to be an AM driver for a final using a 4X150A tube as a class "C" modulated amplifier. In such service as this, a total of only 10 or 15 watts rf output were required. However, should one use this little box as a complete AM phone transmitter in itself, with an output of 50 watts rf, on 220 mc, a modulator of about 75 watts audio would be necessary.

The circuit contains a frequency modulated crystal oscillator operating at 1/6 the output frequency, and originally used crystals in the range from 35.53 to 39.17 mc. In order to cover the 220-225 mc band then, the crystal used would have to be between 36.6 and 37.5 mc, and the FM generating portion of the circuitry would be disabled or eliminated, so that the output from the 1462-A1 would be AM instead of FM.

Since crystals of this range are rather hard to come by, except by hard cash, an alternative arrangement was rigged up in the form of a crystal oscillator-tripler box, mounted external to the 1462-A1, and working into it with a short lead. This scheme will allow the use of common 8 mc rocks, the necessary actual

frequencies being 8148 kc to 8333 kc, to cover the band. Also this new crystal oscillator will be much more stable than the original FM crystal circuit of 36 mc. Should FM be desired at a later date, the unit may easily be put back to its original state.

Power requirements for the full 50 watts of 220 mc rf output will require a plate supply of 500v dc at 300 ma for the final tubes, which are a couple of 2C39A's, and a supply of 300v dc at 100 ma will be necessary for the exciter stages. 6.3v ac at 3.5 amps will be required for the heaters of all the tubes.

Modifications

Refer to the photograph of the unit. The external minibox can be seen mounted to the right of the 1462-A1 transmitter. Closer inspection will show the crystal-tripler excitation lead into the main box from the minibox. Now refer to the two schematics. An original unmodified schematic is shown in Fig. 1. In Fig. 2, are shown the modifications to be performed.

The rundown on the original schematic shows V-101 as a modulator-driver. This tube is not used and may be removed. V-102 was originally the crystal oscillator-tripler. This tube will remain a tripler, but the crystal oscillator function will be performed by the external box oscillator-tripler just described. The diode modulator associated with this stage is disconnected and/or removed. V-103 was originally a doubler. Its operation will become that of a tripler, and no changes are necessary to do this. V-104 and V-105 will remain as is—buffer and driver—as well as the final two tubes, V-107, V-108, performing the function of a straight through amplifier.

In the modification then, we will have the following line up;

New tube 6BH6 as an 8 mc crystal stage (actually 8155 kc for operation on 220.185—the desired frequency)

New tube 5763 as a tripler to 24.46 mc. The above two tubes to be contained in the external minibox.

V-102 as a tripler from 24.46 to 73.35 mc.

V-103 as a tripler from 73.35 to 220.185 mc.

V-104, 105, 106, 107 and V-108, as original with no changes.

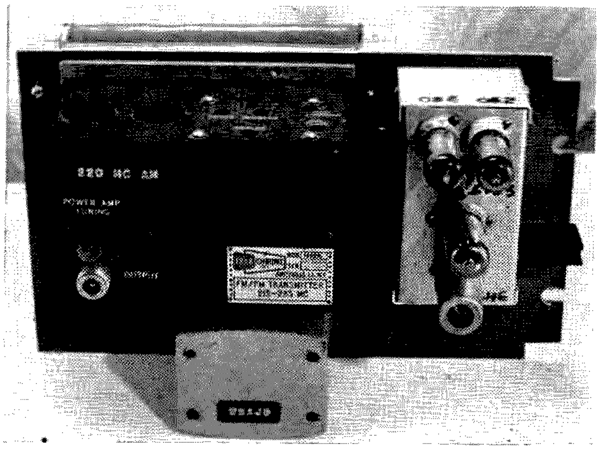
The multiplication is now 27 times, instead of the original 6 times.

The 8 mc crystal oscillator plate supply is derived from dropping resistors in the common 300 volt line and this is further stabilized by a couple of OB2 gas regulators in series, as shown. The 5763 tripler plate coil, which is to be resonant at 24.46 mc, is a slug-tuned unit, one-half inch in diameter, close wound with 16 turns of no. 20 enamelled wire. A short lead of two-inches is then brought out of the minibox and a hole is drilled in the 1462-A1 adjacent to the original crystal socket. This provides coupling between the two units. Pin jacks are used here.

Rearrange the circuitry of the former crystal oscillator-tripler stage V-102, as per Fig. 2, and insert the 24.46 mc excitation from the minibox into the hot pin of the crystal socket of V-102. The plate coil of this stage, formerly resonant from 106 to 117 mc, is now padded with a 12 mmfd fixed high-quality capacitor to make the coil resonant at 73.35 mc. From this point on, throughout the rest of the transmitter, everything is normal and unchanged. All coils may be grid-dipped to their respective frequencies and peaked for maximum after the unit is fired up. A small blower will be necessary to cool the 2C39A's when running maximum power. This may be conveniently mounted behind the rack panel.

Operation

Using a watt meter rated good at 220 mc on the output of the transmitter, all tuning



Front Panel View of the Telechrome 1462-A1 Transmitter.
Minibox at the right of the transmitter contains the 8 Mc xtal stage and the 24 Mc tripler stage. Voltage regulator tubes at top of box.
Short lead couples the 24 Mc component into the Telechrome transmitter at the 24 mc point, which is the former crystal socket. The transformer mounted below the 1462-A1 is a 6.3v ac filament transformer. Tuning controls are on top and on the front of the 1462-A1.

slugs and capacitors should be peaked for maximum output. The input to the final 2C39A tubes will run about 150 watts fully loaded, and at this input, something over 50 watts rf output will result. A properly rated modulator may be inserted into the 500 volt line to the final stage for high level modulation. While this may not be the very best way to modulate a grounded-grid stage, it does work satisfactorily. Should the unit be used as an AM driver for a larger 220 mc final amplifier, as is used at this station, the plate voltage on the 2C39A's may be reduced down to that necessary for the proper rf output. For example, using only 250v dc and drawing a current of 150 ma (37.5 watts dc input) an output of 15 watts is produced. This drives a modified surplus TRA-19 final to 200 watts input, and with an efficiency of 50%, will represent 100 watts rf output into the transmission line. The 1462-A1 unit of course, with its capability of 50 watts plus output, will most certainly drive anything in the way of a 1kw, 220 mc

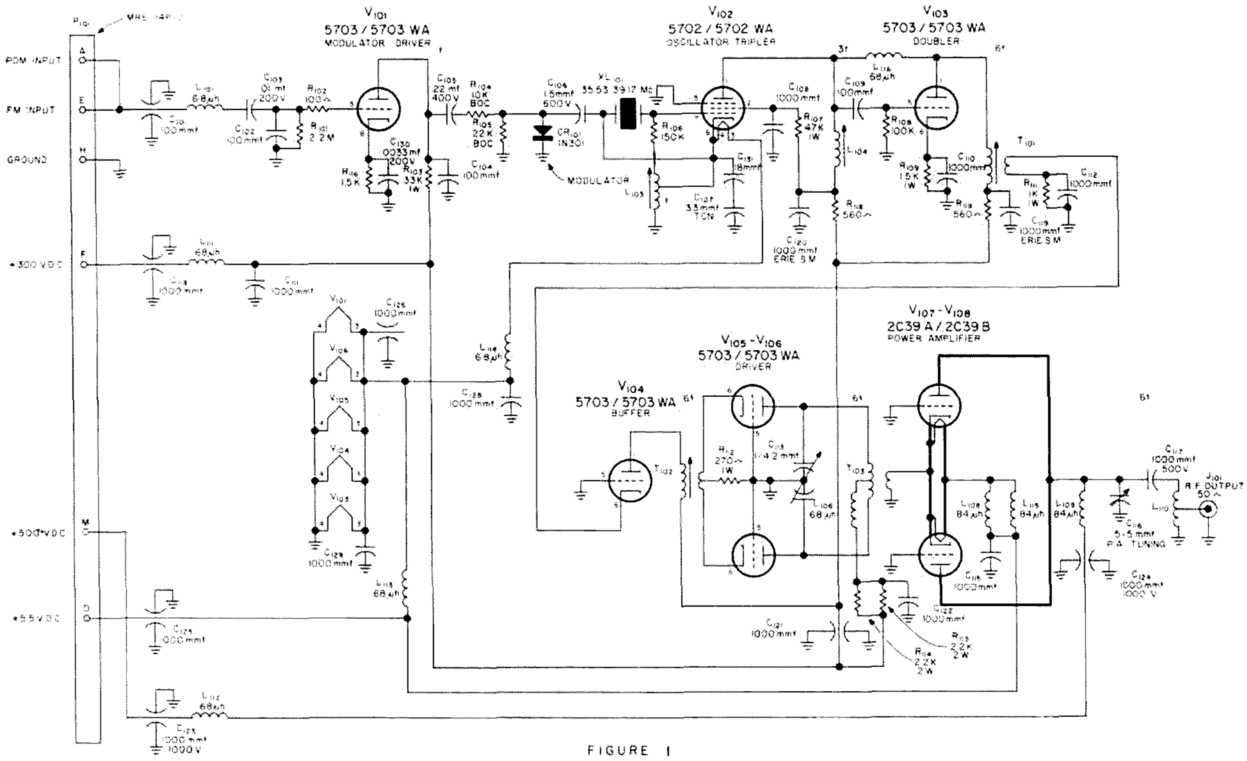


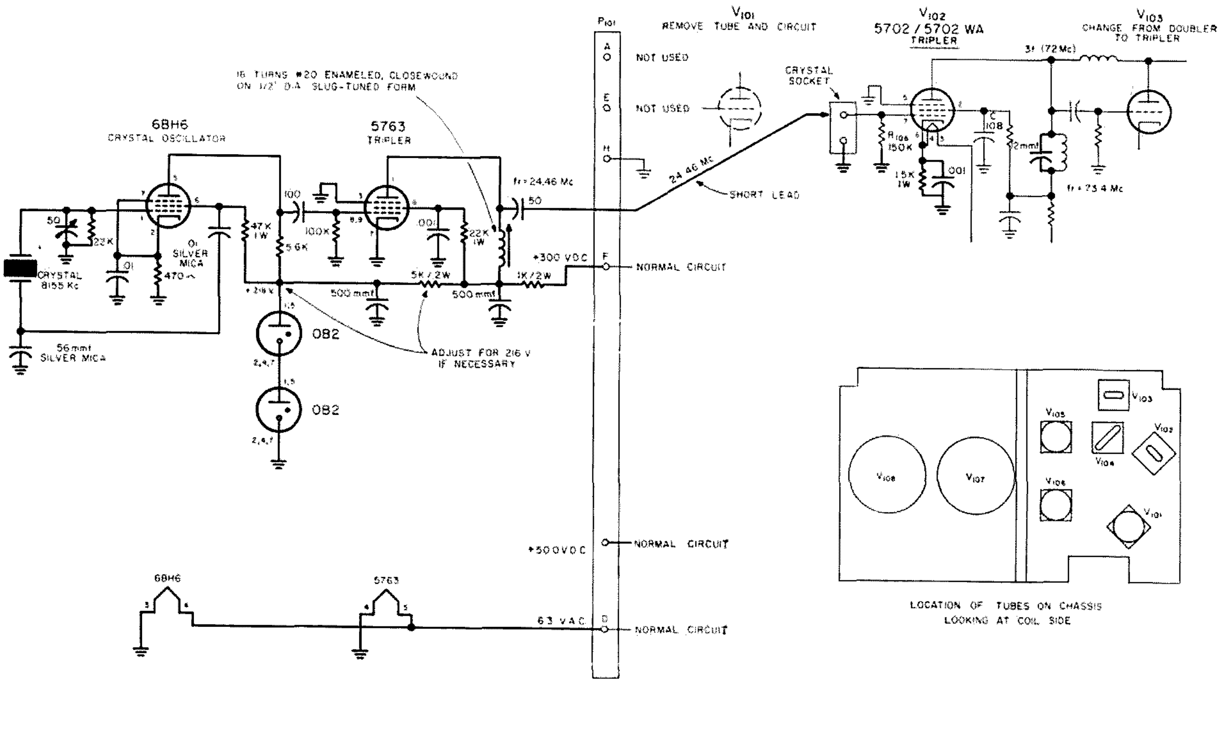
FIGURE I

final, if desired.

Units such as the 1462-A1 are gradually becoming more available as time passes—actually they are more or less obsolete in telemetry applications, and by regulations, the telemetry business will gradually vacate the 216 mc region during the next few years, moving to much higher frequencies.

This sort of a situation should make quite a few interesting equipments available for 220 mc ham operations.

. . . W5AJG



NEW OSCILLATOR-TRIPLER, BUILD IN 4 1/2" X 2 1/2" X 2 1/4" MINIBOX

FIGURE 2

Changes in heavy lines

2 Meter AM & SSB Transmitters from the T-28/APT-1

Leroy May W5AJG
9428 Hobart St.
Dallas 18, Texas

Photo credit: Jim Dungan, Dallas

The surplus transmitter T-28/APT-1 is another in a series of Radar Jamming units which were used during WW-II to cover a wide range of VHF-UHF frequencies. It covers the frequency range from approximately 90-220 mc. Since this excursion crosses the 144 mc amateur assignment, approximately the same techniques used in the conversion of the ARQ-8, elsewhere in this issue, may be used to convert one of these units into a 2 meter AM transmitter or driver. Likewise, a second T-28/APT-1 may be used to convert into an SSB transmitter or exciter, in the manner of the two previously described ARQ-8, 50 mc units. Only the rf sections of these equipments are used.

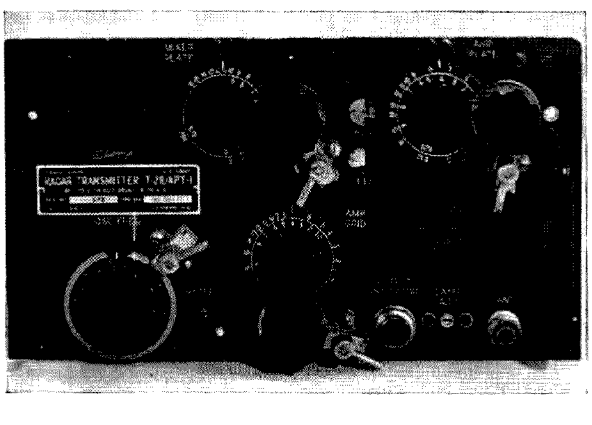
Roller coil inductors (rollo coils) in contact with small wheels riding along the individual turns of the coils are used in this higher frequency T-28/APT-1 unit, and the final stage may again employ either a type 832A tube or an 829B tube, according to the power output desired. Most of the T-28/APT-1 transmitters came equipped with the 832A type installed in the final tube socket.

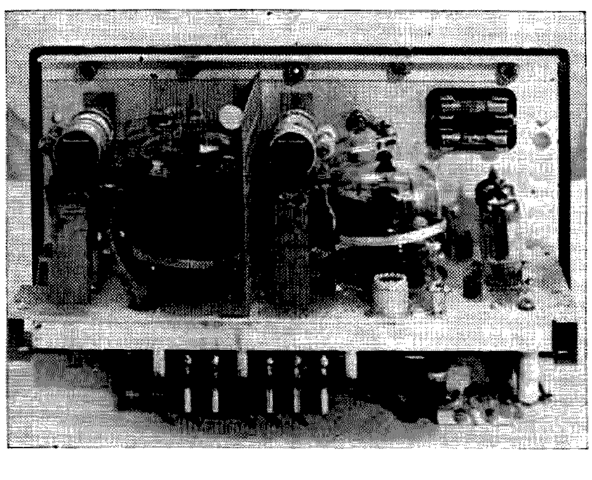
Fig. 1 shows the original wire traced schematic circuit of the T-28/APT-1. Fig. 2 shows the AM modification—and Fig. 3 covers the necessary SSB modifications. Since most of the details given in the previous article, concerning 50 mc, will also apply to the present conversions on 144 mc, it is recommended that you read it before starting these alterations. On these two modified schematic diagrams, the original components are left unmarked, while the added or changed parts are so indicated with their new values.

Power outputs of the units will be somewhat similar to the 50 mc versions, that is, the AM transmitter will produce from 18 to 50 watts carrier power output, depending upon the final tube used, while the SSB transmitter PEP input can be anything from about 35 watts to 150 watts.

Modifications

To convert into an AM unit: The panel mounting arrangement and shielding requirements are identical to the T-51A/ARQ-8 as modified into a 50 mc AM transmitter. In this case of the T-28/APT-1 modified into a 144 mc AM rig, the first order of business is to eliminate the push-pull, self-excited oscillator using type 6C4 tubes, and insert in their place,





a crystal-oscillator, doubler stage using a type 6BH6 tube. Easily obtained 8 mc type crystals may be used here, with the plate circuit doubling to 16 mc. A second type 6BH6 tube operating as a tripler, will multiply the 16 mc output to 48 mc, and this will then be link coupled to the 1st 832A stage grid circuit. As in the previous transmitters, this 832A stage was originally a mixer, accepting rf drive plus wide band noise. This is no longer needed and the stage in question merely becomes a conventional type tripler, with the grid resonant to 48 mc and the plate circuit tuning the 144 mc frequency.

This 832A tripler will in turn drive the final 144 mc straight-through Class "C" amplifier, which will be either an 832A type or an 829B type, depending upon the power output desired. When changing the final tube type, it will be necessary to change the value of the grid resistor as well as the screen dropping resistor associated with this stage. The schematic of Fig. 1 details such necessary changes. A key jack is indicated on this AM version, and should CW operation be desirable, the power input may be upped a bit more, without damage to the 829B tube.

Now, regarding the plate circuit rollo coils when using this maximum type power input—it is true that the heavy duty cycle type Class "C" operation can very likely cause the roller contact of the rollo coils to tend towards some arcing, and possibly some heating, if very much tuning is done under such full power. This was mentioned in the previously published 50 mc AM conversion of the T-51A/ARQ-8, and it was there stated, that somewhat better efficiency might be obtained by removing this final plate circuit rollo coil and replacing with an L-C combination specifically resonant to the operating frequency. Such an arrangement can be duplicated in the T-28/APT-1, if desired, by mounting a coil and variable capacitor resonant to 144 mc in place of the original rollo coil and output circuit. A one or two turn link for rf output will replace the original T-28/APT-1 output circuit. A combination that is useable may take the form of a 10 mmfd per section split-stator capacitor in conjunction with a coil of two turns of No. 12 enamelled wire, wound on a 1⅜ inch diameter, spaced ½ inch, tapped in the center for the HV connection.

If an 832A is used in the final or if the 829B type tube is throttled down in power input, this change in the final L-C circuit is hardly worth while, as no decrease in efficiency or unwarranted heating will occur at about the 20 watt output level. In any event, it is recommended that the original rollo coil be left intact even with the higher power, and if trouble is encountered, then corrective steps

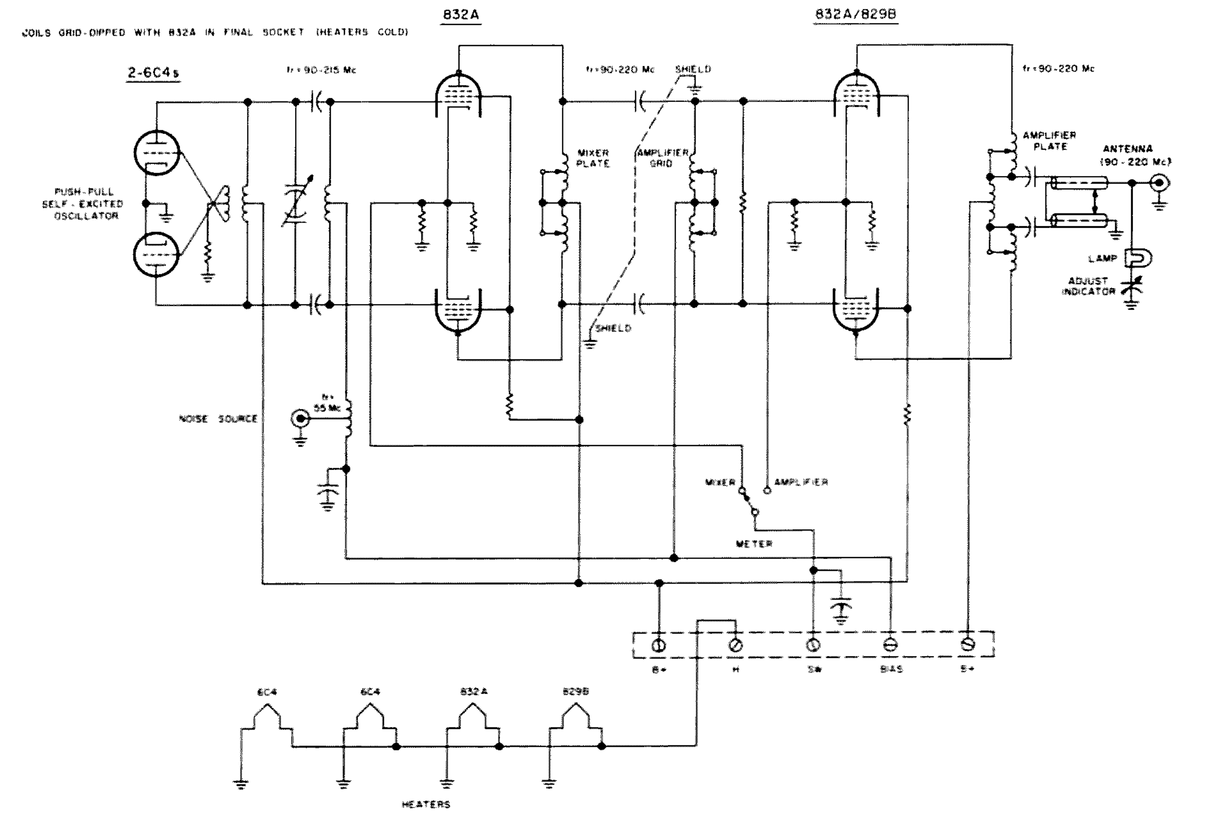


FIGURE 1

can be taken.

Should high-level Class "C" AM modulation be desired, the modulator may be inserted in the high-voltage lead of the final tube. A modulator capable of from 15 to 50 watts audio output will be required, according to the final rf tube selected. Used as an AM transmitter then, one can reasonably expect the following performance; using an 832A in the final, the input for Class "C" AM phone operation will be 32 watts. The efficiency, (dc input to rf output) will run around 55% or so, which will result in an output of about 18 watts carrier power. On CW operation, this input may be raised to at least 40 watts and will result in a 22 watt output carrier. Using an 829B in the final, the input for Class "C" AM phone operation will be 100 watts. The efficiency will run about 50% and will produce an output of at least 50 watts carrier power. On CW operation, this input may be raised to at least 120 watts and will result in a 65 watt output carrier. The screen voltage and current will be about 200v dc and 30 ma. Grid current should run 10 or 12 ma. Keying is accomplished via a closed circuit key jack in the final cathode circuit.

To convert into an SSB unit: Procure a second identical T-28/APT-1 unit and proceed as follows, referring to Fig. 3. The first step here is to replace once more the 6C4's. This time, the crystal oscillator-tripler tube to be installed is a twin-triode 6J6 type. The crystal frequency will be 41.0 mc, tripling in the second half of the 6J6, to 123 mc. This frequency is then amplified by a new buffer tube (6BH6) and this tube in turn drives the first 832A high level mixer via its new grid coil. All up to this point assumes 21 mc SSB energy available from a 20A or something similar, in order to mix to 144 mc. Should another SSB frequency be desired, such as 14 mc, then the injection string will have to be altered to suit. This was discussed at some length in the original article on the T-51A/ARQ-8 set-up. The plate voltage of the crystal oscillator portion of the 6J6, as well as the plate of the tripler, is regulated for best stability. This is procured from an external +150 volt regulated supply and these two stages should run continuously, coming on with the heaters of all the tubes. The four new coils to be wound will be L-1, L-2, L-3 and L-4. The first three are ordinary slug tune units resonant to either 41 mc or 123 mc. The coil L-4 is to be resonated with the 832A tube input capacitance to 123 mc. Coupling from L-3 to L-4 consists of two-turn links on either coil. A new grid-leak of 10k connects from the center of L-4 to ground.

21 mc SSB energy is fed into the cathode of the first 832A through the 500 mmfd coupling capacitor. The screen voltage on this

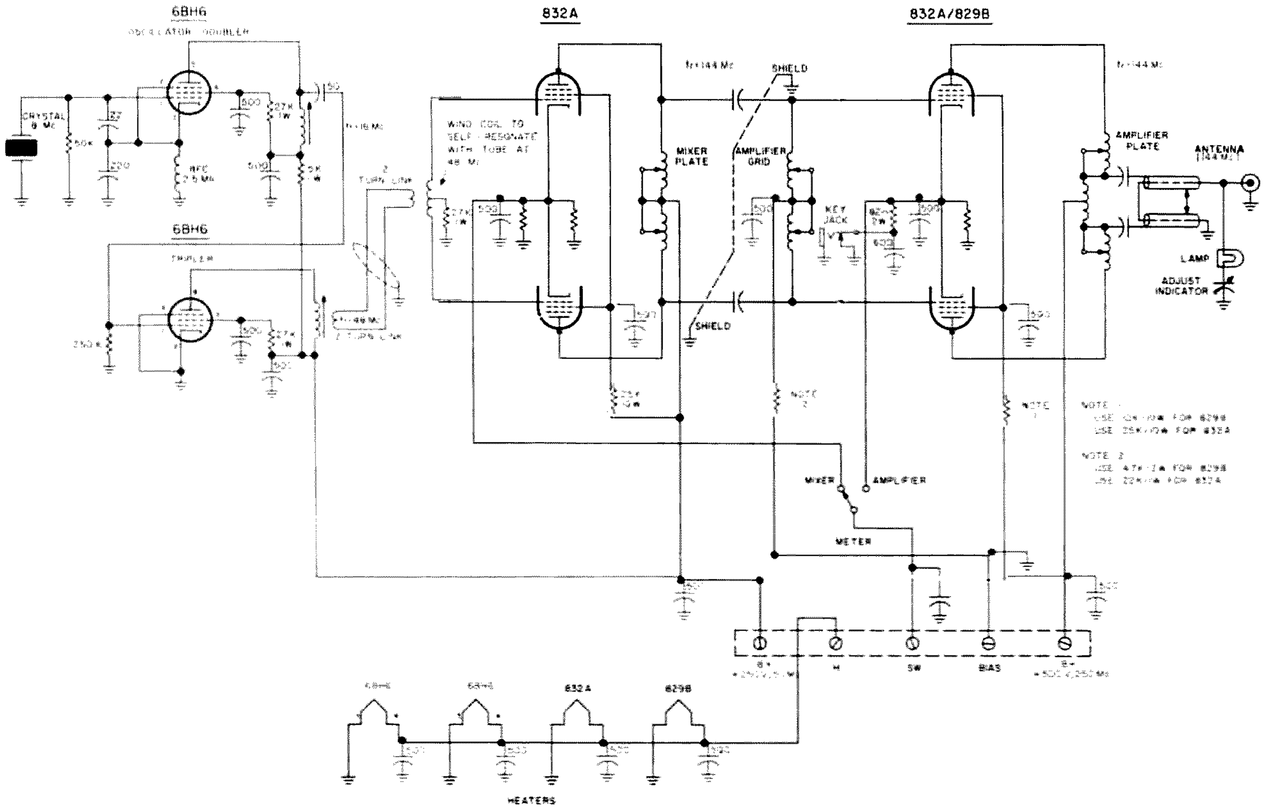


FIGURE 2

Added Components in red

832A mixer tube is derived from a 5k, 5 watt resistor from the 250 volt supply furnishing voltage for the 6BH6 plate and screen and for the 832A mixer plate.

Changes in the final stage to operate in a linear fashion, will first depend on the choice of tubes, either the 832A or the 829B type. The screen grid voltage dropping resistor may be adjusted so that the two OB2 regulator tubes fire properly to provide the regulated 216 volts dc. The rollo coils associated with the plate circuit of the previous 832A mixer stage, the grid circuit of the final and the plate circuit of the final will remain as is. Unlike the AM modification just described using the 829B tube, this SSB version will not require the substitution of a new final tank circuit. This is of course due to the lighter duty cycle of this mode of operation. It will be necessary, however, to provide some fixed bias for the final 832A/829B linear stage to set the proper resting plate current, which will be approximately 10 ma for the 832A and 15 ma for the 829B. This will end up around −15 to −25 volts or so and may be provided by a small silicon supply with a variable pot for exact adjustment.

As for power delivered in the SSB version; Should the 832A be used in the final, an input of from 35 to 45 watts pep may be used. This will result in an output of from 15 to 20 watts pep and will be more than enough to drive any grounded cathode type linear amplifier, such as push-pull 4X250B's to maximum power on 144 mc. Should the T-28/-APT-1 be used as a complete transmitter without a following higher power amplifier, then of course, the choice should be the 829B tube (or perhaps an 5894). This tube will allow an input of some 120 to 150 watts PEP and will deliver on the order of from 60 to 70 watts PEP output. Plate voltage may be anything on up to 750 volts.

This particular unit was checked out at this station using an 829B tube with a plate supply of 600v dc. The screen was regulated at the usual 216 volts and the final negative bias was approximately −25 volts. Resting plate current was 15 ma. With a two-tone test signal driving the final plate current to 100 ma, an output of 30 watts average power was measured. Speech easily drives the unit up to the 70 watts pep output mentioned above.

L_1 = Slug tuned ceramic form ¼" dia—15 turns #24 enem close wound.
L_2-L_3 = Slug tuned ceramic form ¼" dia— 9 turns #22 enem—½" long.
L_4 = 10 turns #16 tinned ½" dia.—1" long winding—center tapped.
(Resonate all coils to frequency with GDO)

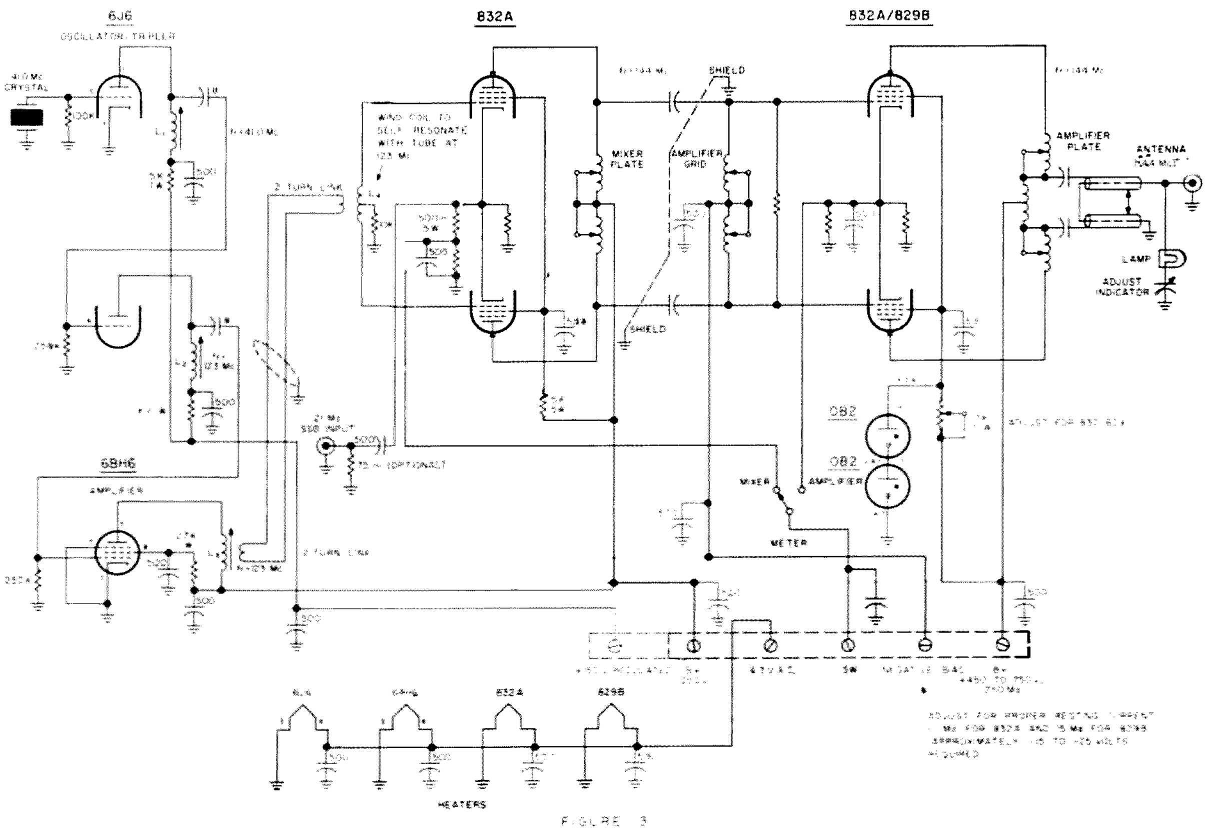


FIGURE 3

Added components in red. The "mixer" lead (shown in black) coming from the meter switch should be connected to the center point of the resistor divider (shown in red) in the cathode of the first 832A.

The rollo coils will not require retuning unless excursions in frequency of more than several hundred kilocycles becomes necessary.

A word about TVI. According to the local situation, it may be necessary in some locations to go to a bit more trouble in the shielding of this unit, as well as filtering of the heater and plate supply leads. Standard de-TVI procedures should be used. Also close attention should be paid to ascertain if any unwanted spurious products are present due to the mixing process. Be very careful to see that the injection frequency used to mix with the SSB energy does not leak through the final. Either 130 mc (used with 14 mc SSB), or 123 mc (used with 21 mc SSB) must not be allowed to radiate. A reentrant cavity filter between the transmitter *if* feeding the antenna or between this transmitter and the following higher power linear, is excellent insurance towards helping prevent troubles of this nature.

Further Suggestions

The preceding work was an assignment project of the Central Technical Net of A.F. MARS in Texas and as such, several of the units were distributed to different workers for experimentation.

One interesting variation originated with K5JHG Skeets Hogan of Atlanta, Texas, who came up with a very simple modification to put the T-28/APT-1 to work on NBFM on 144 mc. Essentially, this modification follows the above described AM version alterations, but with the following changes referring to Fig. 4, instead of using type 6BH6 tubes in the crystal oscillator-multiplier string as set forth in Fig. 2, K5JHG substituted a type 6AK5 for the crystal oscillator-doubler, and used a 12 mc crystal—doubling in the plate to 24 mc. This then, drives into another type 6AK5 doubler with its plate circuit resonant to 48 mc. From here on out, the balance of the modification follows that of Fig. 2—that is—the 48 mc energy is fed into the first 832A tripler tube of the T-28/APT-1, and thence to the final.

To accomplish the NBFM bit, a type 6SL7 double triode tube is used as a speech amplifier with a carbon mike inserted in the cathode of the first section. The plate of the second amplifier section is coupled through a capacitor of .01 mmfd to the screen of the 6AK5 crystal-doubler tube. Apparently, the audio voltage from the 6SL7 impressed across the screen resistor of the 6AK5 modulates the electron stream of the tube, accomplishing a combination of both frequency modulation as well as

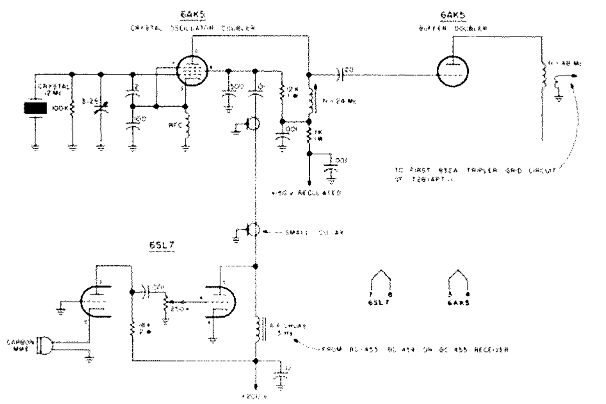


FIGURE 4

some residual amplitude modulation of the crystal-doubler tube. Since the multiplier stages following this tube operate under Class "C" conditions, the AM component is virtually washed out by the FM limiter action, and when multiplied to the final frequency of 144 mc, only NBFM remains. K5JHG uses this T-28/APT-1 NBFM unit as a driver for his 144 mc 4X150A final amplifier as well as a driver for his 432 mc tripler set. This arrangement appears to work very well on both 144 mc and 432 mc and is mentioned as a further example of the versatility of the T-28/APT-1 surplus set.

Other arrangements may also be used to produce frequency or phase modulation in the T-28/APT-1. Several schemes are discussed by Frank Jones in his "VHF For The Radio Amateur." A very attractive scheme is the bridged-T type phase modulator uesd in conjunction with 8 mc crystals and could conveniently be adapted to this T-28 unit.

. . . W5AJG

On receiving 3 copies of 73

Of strange status symbols I often have heard,
But a three copy family's strangely absurd.
There's one for Me, and one for my filius,
And one for my Wife—that's kind of silius.
My son only eats it—he's less than a year, . .
Says my wife, ". . . Homebrew means some kind of beer?"
Yet even so, I think the joke is immense,
Not merely because it's at Wayne Green's expense,
But in 73 humor's endemic,
And 'Twas easy avoiding a lengthy polemic.
So like Egypt's kham-sin-in March invariable,
I need no fourth since that's only buryable
Similia Similibus Curantur
Bob Robbins—K3HTB

Correspondence from the Members

Letters we bet you won't see in QST

Gentlemen:

Thanks for your notice of expiration of my membership in the ARRL.

In reference to the second paragraph on the expiration notice, I have decidedly NOT valued my membership in said organization, inasmuch as it seems they are now making every effort to cause me to lose the Amateur Radio License (Conditional) which they helped me to get.

Over the past omnths I have carefully studied both the pros and cons of the current controversy which your organization has promoted as regards incentive licensnig, and I feel that the ARRL, which through never-tiring efforts, is even today swelling the ranks of Amateur Radio through the media of its organized classes, contests, certificates, etc, has achieved the pinnacle of hypocrisy in submitting, without the concurrence of the membership which it claims to represent, a petition, the results of which must, according to one's viewpoint, either severely curtail the privileges of a large percentage of American radio amateurs or present a minority group of same with unwarranted (not un-earned, but un-warranted) privileges at the expense of the larger group.

I do not write this letter in argument to statistics—you, not I, have the statisticians in employ. I do argue that it is your campaigning which has created the current crowding of the amateur bands which you so deplore; Yet, while the right hand deplores this crowding and solicits legislation to alleviate it, the left continues to campaign for greater memebrship (and crowding) in the ranks of Amateur Radio. Neither do I refute the statements which imply that your fear the "young nations" of the world will have little sympathy for a group of radio amateurs in the United States. I do, however, to a considerable degree listen to the amateur bands in Europe, and at the same time study enough international politics to realize that the elimination of the privileges of a large group of U. S. licensed radio amateurs to the benefit of a minority thereof will not make one iota of difference to these "young nations" in their clamor for more of the radio spectrum.

From the above expression of my opinion, gentlemen, you will perhaps have some inkling of the reason for my failure to renew my membership, and for my campaigning within my modest circle, for others to follow my example.

I have for some years been a member of another organization which claims to represent the desires of its membership, and from experience with it I have become highly critical of organizations which pay lip-service to representation, vowing never again to knowingly maintain connections with an organization which follows the "You boys just keep quiet and do what we tell you—we know what's best for you!" line. I refer to the Air Line Pilots Association, once powerful and with a fanatically loyal membership; subject within the last two years to a devastating internal political shapeup, including a loss of 20% of their paying membership—all as a direct consequence of a ". . . we know what's best . . ." philosophy, and an unwillingness to swallow their pride, back down and follow the will of the membership.

The purpose then, of this letter, is to answer a question and to ask one. The question "Why are you not renewing your membership?" I have already answered. The question I direct to you is: Are you gentlemen of the ARRL board smarter than the deposed politicians of the ALPA—can you learn by their mistakes, or will you, as they did, ignore the clamor of the members until the organization threatens to topple?

Robert G. Gross, Jr.
WA6YGX/DJϕIC

Dear Mr. Huntoon:

I received your form letter of welcoming me back to the League for another year. Before you go ahead and use my rejoining the ARRL as part of your statictics of being in favor of the Leagues proposal RM-449, please read on.

At the beginning of this fine mess that the League had started, my first thought was to let my time run out of being a member of the ARRL. Then with a little more serious thought I decided that the right way is to do my best and help (by vote) put a director in office who cannot be "brow beaten" and become a "yes-man", once he returned to the "Home Office". If enough areas would work on this program I believe the League would be in a much better position than it is now.

So my main reason of rejoining the League is to cast my vote for a new Southwestern Division Director and to cast my vote (if we are ever given that privilege by the League) against **RM-499.** I am sick and tired of reading of the so-called 16-0 voting by the Directors! ! The ARRL has torn apart a fine organization and has set it back at least ten years!

Not only am I a member of the ARRL. I have also joined The Institute of Amateur Radio. The ARRL Booster Pin I once proudly wore not sits in the dresser drawer, my efforts now will go to the IOAR to help make it a stronger organization.

Maybe stronger competition will make the ARRL sit up and take notice that they do not control as many of its members they think they do.

The League is a great one for different contests, why don't you put your heads together and come up with some types that would make 10 and 15 meters the MAJOR bands. Help promote these bands now and we stand a great chance of keeping them.

It is very true that the commercial field is looking at our bands for the relief of their crowed bands. But the way you plan is far from the answer.

Donald A. Cofone, W6RDB

Dear Sirs:

I am returning the enclosed notice of subscription expiration I do not wish my subscription renewed.

Since subscribing in 1956 I noted that QST was not aimed at the man who was an "operator" and an "amateur". The articles were consistantly slanted toward the technician who was a semi-professional in the electronics field. Older hams told me at the time I received my license that "you get the deep stuff in QST and useable information in CQ". As CQ in recent years has followed QST the hams now refer novices to a new magazine "73" for the same reason they used to recommend CQ.

There is, of course, the matter of league membership. Yet, to support an organization, one must feel the organization supports the majority of its members. This the league does not do. Whether it is in aiding those defending themselves against a lawsuit aimed at all of us, or in recognizing that the vast majority of its members are general and conditional class (according to the leagues own figures) and setting policies accordingly, the league fails.

Its officers consider themselves a technological elite for whom the FCC must make special provision in its regulations to the detriment of the majority of the membership. No organization can expect to receive membership support on such a self-centered policy.

Even the arguments put forth by the league in its plea for higher technical requirements for licensing are confused. *In effect it says: "Because manufactured rigs are* better and cheaper than those a ham can make, a ham does not need to know so much—so we propose that he be required to know more.." This is certainly moving in a direction opposite to the presented evidence. Another hams petition giving the lower end of the CW bands to Advanced and Extra licenses for phone would deprive no one and still provide an incentive. *These frequencies are* empty and the CB's may get them (or commercial interest).

As a conditional licensee I do not appreciate the leagues' point of view that I hold a "Sears and Roebuck license". An ex-army air corps radio operator-mechanic, I found the examination simple despite a 12 year absence from code operating. I am not only active in many public service projects, but originate many of them (see page 60, June 1961 CQ). Being a freelance writer I see that the local newspapers where I am stationed know we do more than cause TVI. I hold nothing against the hot soldering-iron types, but I make my contribution to ham radio too.

QST has just not kept up with the "state of the art."

Ross A. Sheldon K4HKD (ex K5UCH)
Huntsville, Alabama

FCC Rule Changes

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The following rules changes have been made by the FCC, effective March 18th.

§ 97.13 Renewal or modification of amateur operator license.

(d) *Application* for renewal and/or modification (change of address, etc.) of an amateur operator license shall be submitted on FCC Form 610 and shall be accompanied by the applicant's license. Application for renewal of unexpired licenses must be made during the license term and should be filed during the last 60 days of such term. In accordance with the provisions of this quarter, made timely and sufficient application for renewal of an unexpired license, no license with reference to any activity of a continuing nature shall expire until such application shall have been finally determined.

e) If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date. During this one year period of grace, an expired license is not valid. A license renewed during the grace period will be dated currently and will not be backdated to the date of its expiration. Application for renewal shall be submitted on FCC Form 610 and shall be accompanied by the applicant's expired license.

§ 97.47 Renewal and/or modification of amateur station license.

(a) Application for renewal and/or modification (change of address, etc.) of any station license shall be submitted on FCC Form 610. In every case the application shall be accompanied by the applicant's license. Applications for renewal of *unexpired* licenses must be made during the license term and should be filed during the last 60 days of such term. In any case in which the licensee has, in accordance with the provisions of this chapter, made timely and sufficient application for renewal of an unexpired license, no license with reference to any activity of a continuing nature shall expire until such application shall have been finally determined.

(b) If a license is allowed to expire, application for renewal may be made during a period of grace of one year after the expiration date. During this one year period of grace, an expired license is not valid. A license renewed during the grace period will be dated currently and will not be backdated to the date of expiration. Applications shall be submitted on FCC Form 610 and shall be accompanied by the applicant's expired license.

Letters

Dear Wayne,

I have never felt the necessity to write to an editor before, but considering the effect that the ARRL proposal would have on our wonderful hobby of amateur radio I believe it is very necessary for me to express my views on the matter.

When the ARRL first introduced its so-called "Incentive Licensing" program I wasn't very impressed by the idea, since it would mean wasting time memorizing answers to more test questions, time which could be better spent experimenting or increasing operating proficiency; and this to retain what we already have! Other reasons for opposition soon came out, reasons which were consistently more sound than those for its support. For one thing human nature cannot be changed by legislation. Congress tried to do so by amending the Constitution to prohibit the sale of liquor in the United States, thereby hoping to promote temperance among Americans; however it soon became apparent that, if anything, more people were drinking because of this law than less, and the 18th Amendment was soon repealed. The current civil rights controversy is also a good illustration. Thus if amateurs are indeed a lazy lot, as the ARRL seems to think, stiffer tests aren't going to change things one bit.

But I don't think that most of us are so technically ignorant. Many hams here in Moorhead have very well-equipped workshops and spend much time on home construction projects; it there any better way to bring home textbook data than in terms of practical experience with the theory involved? On-the-air discussions also often center around technical problems encountered with transmitters, antennas, etc. Hams lazy? I think not.

Further, if this proposal were placed into effect it would cause a considerable increase in work and expense for the FCC. They would be compelled to spend large sums of money (our money!) devising and printing all of the suddenly required tests; moreover, since there is no differnce in calls among the Conditional through Extra classes it would be very easy for the former to continue using the latter's "privileges" unless the FCC hired many more monitors to police us (more of our money). I have always favored minimum government intervention in anything, and this is certainly much more than minimum.

These are all very good reasons for opposing the measure, but the clincher appears, ironically, in QST itself. I am referring to the "Correspondence from Members" columns in several of the recent issues. After close scrutiny it became evident that there was more than chance involved in the order of the letters. One or two would first appear opposing the measure, abruptly followed by one in favor of it arguing on the same points, as if to refute the previous points. This sort of spacing has been too consistent to be mere coincidence. Does the ARRL have so little confidence in the merits of the proposal that it must resort to tactics such as these to win approval of it by us amateurs? Does it, indeed, have any merits good enough to have it forced on us by government decree?

I am sure the ARRL is sincerely interested in improving the technical calibre of amateurs in general; but there are means of doing this that are much better than such drastic proposals. One of these is to change the structure of QST magazine. At present only about a third of the magazines is devoted to technical material; what is there is excellent, but there isn't enough of it. Even the ads lean very heavily toward commercial gear. So why not have QST feature more theory and construction material and solicit more ads concerning parts needed in homebrew equipment, rather than placing so much emphasis on operating and completely commercial gear.

However, if we still must accept more government control there are still better ways of accomplishing it, and much less expensive too. Begin by giving Advanced and Extra closs licensees their own distinctive calls; then give each of these two classes phone privileges on small portions of what are now CW only segments. This would be true incentive licensing. The higher grades would then become real status symbols, and be something to work for.

So I believe that this proposal is not only unnecessary but also very unwise. Thank you for giving me this opportunity to express my opinions.

Dave McFarland, WAØDAM

Our Readers Answer CQ's Editorial

Dear Wayne:

Well, well, well . . . CQ finally got off the fence. I wonder who pushed them?

I fully agree with the Editor of CQ that one should be a little bit more sure of his facts before running editorials, but I guess he wasn't too worried about this because he was leaving anyhow.

Just for the amusement of it, lets see what he said:

1. "The time "To Be Counted" statistics were written before the ink was dry on the February issue." As you will note this answer to a May editorial appears in the June issue and Wayne did not have to skip a month to answer it. So much for that.
2. "The CQ proposal was warmly received." No argument, it should have been, as it was completely unoriginal and on the only point that was raised, i.e. power increase, they took their lumps. Any active ham would have known this would happen.
3. "They have made no proposal before the FCC", real safe isn't it, to have a proposal and make no proposal.
4. Yes you have more than just one call as do thousands of other amateurs who also possess a citizen's band call, including the editor of CQ and his boss, the son of the publisher of CQ. (By the way Richard, isn't it time you at least tried for your General?)
5. An accounting of the monies of the Institute of Amateur Radio was presented to its Board of Directors and appears in the previous issue of '73' and prior to any requests for same. It clearly shows zero expense reimbursement. How much has CQ spent to benefit anyone but CQ.
6. CQ claims that your petition to the FCC is similar to theirs. Your petition was filed February 20th, before the March issue of CQ was out after having first appeared in the January issue of '73' (you will note that this is the required time, according to CQ to do a copy job) so . . . assuming it is true that the proposal appearing in CQ is similar to yours and yours appeared two months before theirs, I leave it to you as to who is the copycat.

I would suggest that engaging in a name calling contest, you check your own skirts to make sure they are clean. The ARRL was invited to check the count and postmarks on 73's ballot. Neither they, nor CQ requested to do so.

Sounds like the old saying, "Don't confuse me with the facts, my mind is made up."

I sincerely hope the CQ Editor enjoyed his name calling game and "when did you stop beating your wife" type of questions. Every child is entitled to a tantrum once in awhile.

Good luck on his next job.

IoAR Member
New York

By W4RLS

CQ Magazine in its May, 1964 issue, contained an editorial headed "Zero Bias," which was nothing more than a character attack upon Wayne Green, the editor and publisher of **73 Magazine**. Numerous comments have already been made on the air by various amateurs to the effect that character assassination like this has no place in the pages of purportedly responsible publication, and it is certain that the heading of the column is unworthy and untrue, in view of its obviously heavily biased content. This writer would label the column "Zero Potential," because it certainly is totally without voltage in our eyes!

Wayne Green normally needs no help in defending himself, and that is not the purpose of this letter. My purpose is simply to protest this kind of vicious attack in print on anyone.

First, the accusation is made that Wayne tallied the votes on his postcard poll concerning RM-499 before the ballots were distributed. This is the sort of irresponsible approach which Mr. Goebbels used to such good advantage about thirty years ago in Germany. Wayne has offered in the May issue of 73 to allow the ballots to be audited and has asured the A.R.R.L. that every ballot which they have been informed was mailed in favoring RM-499 is definitely included in the group. The entire collection is there, and before anyone hurls the lie at Mr. Green, that someone ought to accept his invitation to audit those ballots! The results of his poll, eighty per cent opposed to RM-499, are borne out in my eyes by virtue of the fact that examination of the file which the FCC has compiled on RM-499, previously reported in 73, showed the same ratio of opposition.

The second accusation is that **73 Magazine** changed its attitude on incentive licensing. Whether it did or not is not the question, for certainly CQ did the fastest turnabout on record on its March issue! From a position of abject camp-following, swallowing the A.R.R.L. line hook and sinker, suddenly **CQ Magazine** discovered that there were possible methods of incentive licensing other that RM-499! Evidently, the editor of **CQ** has been reading **Monitor**! Since I orginated the so-called W4RLS Plan, which has by far the most support of all the proposals in the FCC file, based on the signatures in that file, I am particularly gratified that both **73 Magazine** and **CQ Magazine** have adopted similar positions. Nevertheless, I do not consider that **73** turned its coat, since the position now occupied by **73** is, to my view, not inconsistent with its previous opposition to the A.R.R.L. form of "Incentive Licensing". The position now adopted by **CQ** on the other hand, is in direct opposition to its editorial position to which it held through February, 1964, and then suddenly turned 180 degrees out of phase in the March issue of the magazine, with no explanation and no apology for the sudden turn in direction. The editorial in CQ further accused Wayne of deliberately misguiding his reads, of malice, and of himself joining the ranks of "Me Too'ers." Now the CQ editor made his determination of "Deliberately" misguiding his readers, and how he arrived at his conclusion of malice, he does not explain. He offers no evidence. Perhaps he can read minds? Accusations like this have no place in the field of honorable discussion. Nor do I believe Wayne to be guilty of the accusation that he has also become a "Me Too'er." What he advocates in his currently

pending FCC petition (RM-577) is closely parallel to the W4RLS Plan, and is greatly different from RM-499. I happen to be in position to refute the accusation that Wayne borrowed his proposal from **CQ Magazine.** I had been in correspondence with Wayne for several months concerning the W4RLS Plan as opposed to RM-499, and I know that Wayne's own version of this approach to incentive licensing was his own and was not borrowed from the March issue of **CQ Magazine.** Quite the contrary, I strongly suspect that both plans, that of Wayne's and that of CQ's, were greatly indebted in their inspiration to the W4RLS Plan!

The "Zero Bias" editorial contains an entire paragraph amounting to no more than a character assassination attack, a mere diatribe, and reflects more discredit on its author than it possibly could upon its target. I am also in position to know that the accusation leveled at Wayne of organizing he Institute of Amateur Radio just to grab off $10.00 donations for his own pocket is utterly false. I am one of the organizing directors of that organization, and am going on record here and now as stating that not only has Wayne offered free space in **73 Magazine** to report the doings of the Institute, but that every dime of the money has been accounted for, is in the possession of the Institute, which is duly incorporated, and that Wayne refused payment for the free space in **73 Magazine,** despite the fact that the directors did not think it was fair for the Institue to ride free and urged him to accept payment. He stated that he wanted to go "the last mile" in order in every way to show that he had no profiteering motive in connection with the Institute. He wanted to protect the Institute from the sort of false accusation as the one under discussion.

Certainly, a subscription to **73 Magazine** is extra. The purposes of the institute are strictly limited to an attempt to benefit amateur radio. It is not the purpose of the institute to boost a magazine. The directors expect to run the institute and try to carry out its program and purposes which are intended to supplement those of the A.R.R.L., and to fill in the areas where A.R.R.L. either will not or cannot take the necessary action for the benefit of amateur radio.

I do not pretend to agree with any one person fully, nor to claim perfection for anyone, including myself. Nevertheless, I am proud to be associated on the board of IOAR with such men as the following: Bill Ashby, K2TKN; Wells Chapin, W2DUD, Lloyd Haslam, W3AYA; Maurice Hinden, W6EUV; Harry Longerich, W2GQY/4; Ed Schaad, WA4PDX (W9AIY); Howard Pyle, W7OE; Warren Cannefax, K4AQV.

Harry Longerich is already on the ground in Washington, D. C. as the institute's representative, "lobbyist" if you want to call him that. At any rate, amateur radio now has a man in Washingon, on the spot, for the purpose of selling amateur radio to our own government. The editor of **CQ Magazine** ought to spend his time thinking up or at least boosting progressive ideas to help the cause along, rather than wasting his time, words and venom in personal attacks on others.

Foy Guin, Jr., W4RLS

Letter

Dear Wayne:

Just a note in connection with your editorial in April 73. I would like to say that I feel your idea of giving considerable space in 73 to the qualifications of persons running for the position of ARRL director is a fine idea. During the last southwestern election I was fortunate enough to hear equal time speeches given by all candidates at the Los Angeles Council of Radio Clubs. Needless to say only a small fraction of the division's voting amateurs had such an opportunity, and the small biograhy with the ballot is certainly not enough.

Best wishes in connection with the IOAR and the "man in Washington" project.

Harvey
WA6KZI

Using 416B and 8058 Tubes as 432mc Preamps in the CFN-46ADT

Leroy May W5AJG
9428 Hobart St.
Dallas, Texas
Photo credit: Jim Dungan, Dallas

In *73* Magazine for November 1963 there was described a 432 mc converter using the surplus Navy type CFN-46ADT, rf to *if* converter. This was a transponder type military unit as used with a companion radar installation. Towards the last of the article, under "Further suggestions," it was stated that the substitution of W.E. 416B planar triodes, in place of the original 2C40's in the rf stage would improve the operation of the converter in a very substantial way.

It was further stated that the type 8058 nuvistor type had also been substituted for even the 416B's in an effort to evaluate the performance of this newer type RCA tube.

The first thought which will probably come to mind is; which will be the best—the 416B or the 8058? Which route should I go? This is a tough question, and some aspects of the problem will first be discussed, thereby perhaps helping one to decide which road to take.

Here at W5AJG we have modified two of

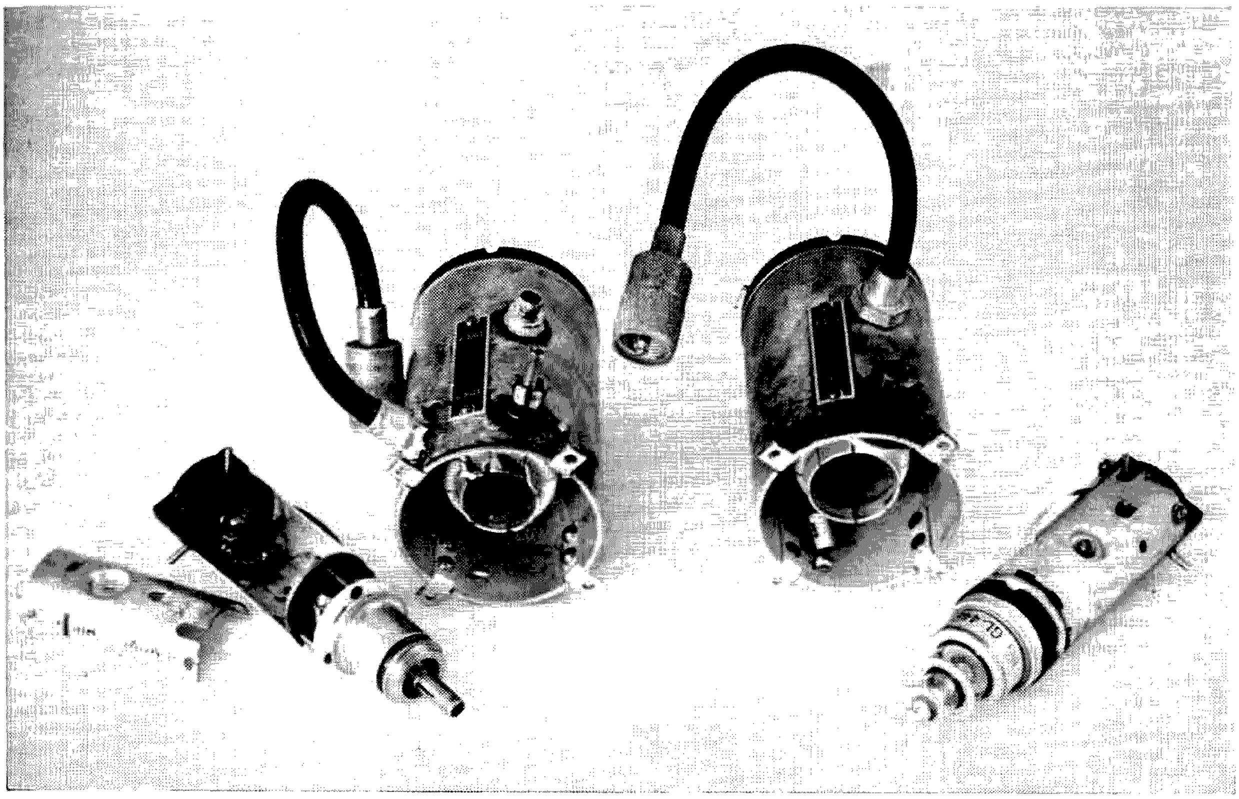


Photo showing modifications to the cathode tanks of the 46ADT to adapt for 416B gold plate planar triodes in place of the original 2C40/446B type tubes. Tank on the left is the modified one. Tank on right is the original unmodified one. Input coax is coupled in to the bottom of the cathode line (at tube) on the left hand line in contrast to the right hand tank where it is coupled in further towards the ground end of the inner conductor.
Silver plated fingers on the left hand tank are bent inwards to firmly contact the cathode shell of the 416B tube.
A quarter inch copper tube extension of the plate cup makes up for the total length deficiency of the 416B tube version.

the 46ADT units. The first allows us to try 416B type tubes in the two rf stages. The second 46ADT chasis allows us to try the two rf stages of 8058 nuvistors. The two units are quickly interchangable into the same mixer system and thence through the remainder of the receiving setup. In six months of service on the 432 mc band, using out of town signals for comparison purposes, we can truthfully say that we can not tell any practical difference between the two tube types. Therefore, in nearly all cases, we feel the choice would be made for other practical reasons—as to whether it would be 416B's or 8058's on 432 mc.

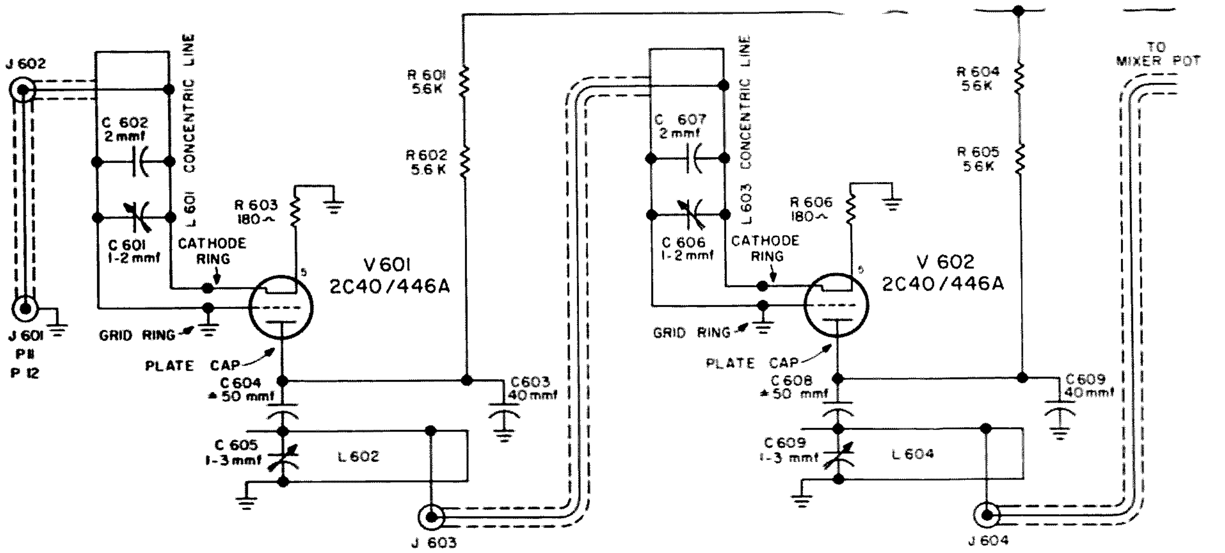
One or two of these practical reasons might be explored a bit before we proceed. The 8058 nuvistor sells for $13.25 at the present time. Right off then, an expenditure of $26.50 must be immediately justified. As against this, the 416B's will cost nothing—in the majority of cases—or at the most, three or four dollars per tube. How important is money, anyhow?

Ease of construction? Well, the 8058's will probably be the easier to get built and plugged in, but there is no great advantage one way or the other. One of the most attractive things about the 8058's will be the absence of any blower—and the low plate voltage required. Using the 416B's at maximum rated electrode voltages, a blower is definitely necessary. Using them at reduced ratings, both as to plate and heater voltages, blowing is definitely *not* necessary. This latter condition is the arrangement that is used and will be described for the 416B's as used in the 46ADT unit.

To boil it all down then—this means if you have the dough, go 8058's. Even if you are rich (but tight), or if you are plain stinking poor, the 416B's will be the route for you.

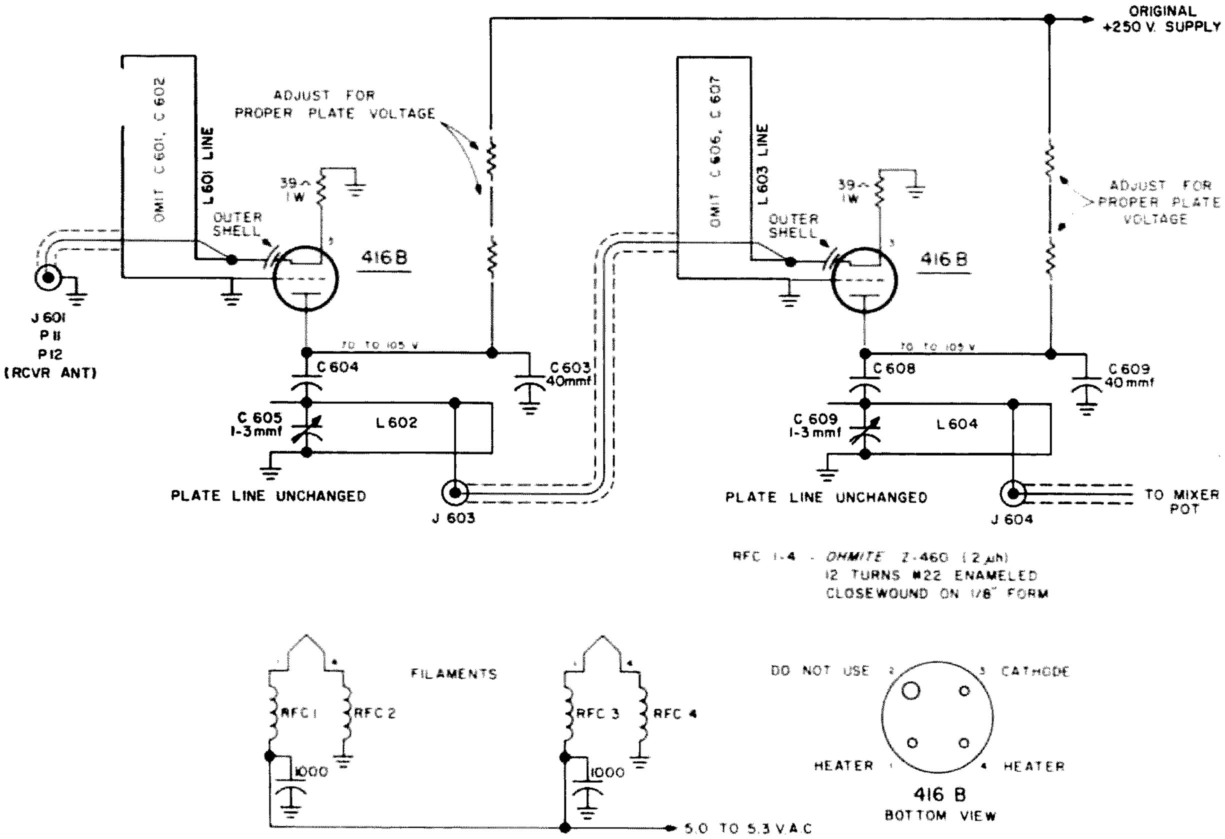
K5JHG, Skeets Hogan of Atlanta, Texas, first suggested the feasibility of modifying existing surplus quarter-wave coax-cavity tanks to accept the 416B gold plated triode tube. Many of these WWII surplus units were designed to use the then new 446A/B or 2C40 type planar-triode tube and with small changes, can be made to work excellently with the 416B type, which is of course, much superior in its performance. The majority of these surplus tank circuits are beautifully built, silver-plated and are unusually stable devices with no signs of monkey business, even when used in cascade fashion. The 46ADT is such a unit.

Before going further into details of the conversion, a word about the method of testing. It must be stated that no test equipment was available to actually measure the absolute noise-figure of the units. A simple diode noise generator was on hand and was used to start



Original unmodified schematic of the first
2 rf stages of the 46ADT unit.

with, but as stated earlier, our best method turned out to be actual "on the air" signals, coming from either K5JHG, located about 175 miles distant, or from W5HPT, located 40 ground miles away. On both these test signals, the antenna was nulled for a very weak signal in those cases when the band was treating us well. On other occasions, when signals were naturally weaker, the nulling process was not always necessary on the 175 mile circuit. Both of these stations possess automatic "V" wheels and they would graciously put their transmitters on the air for extended periods while the various pre-amplifier combinations were tried. Ordinary 432 mc signal generators were of little value after one was in the ball park, as



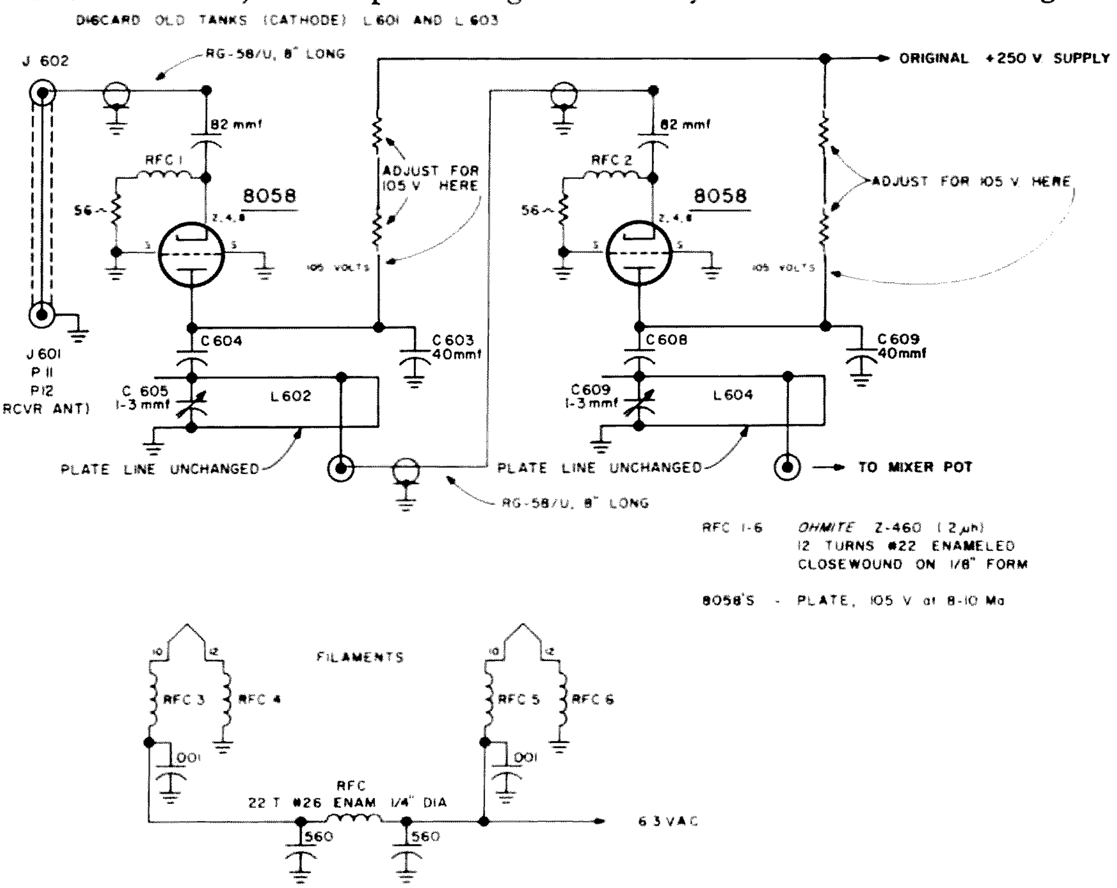
Modifications in red of original circuit to
use 416B type tubes.

the signal could never be counted upon to completely arrive via the antenna. These out-of-town signals have only one way to arrive and comparisons were easily made with front-end tuning and tap adjustments easily detectable.

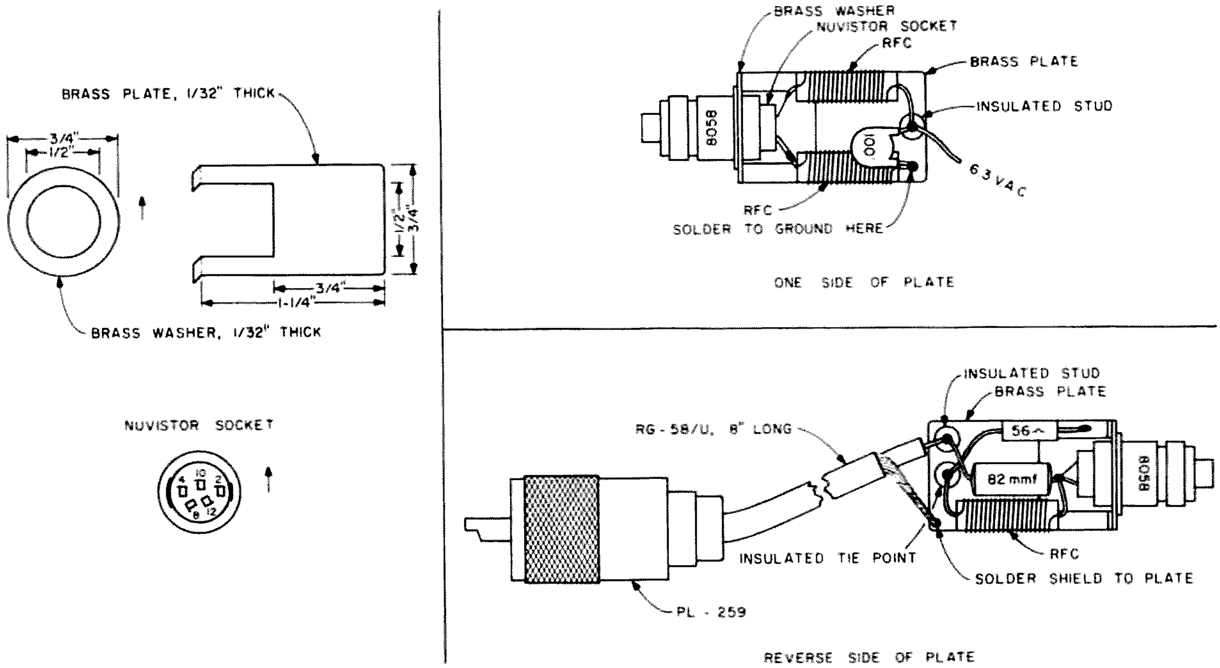
This is admittedly not a very scientific approach, I suppose, but unless one can borrow hundreds of dollars worth of test gear to do the job, this practical S/N method just described will certainly work, and really, all this noise-figure business simmers down to just how good or bad our S/N ratio actually turns out to be on that QSO. At least, this "bonehead" method takes in the antenna and transmission line during the tests—something a noise generator can not very well do. It was definitely found that the proper time to compare anything in the way of rf amplifiers on 432 mc, was when the band was poor—not when the band was hot. Anything works then, and comparison is difficult with extremely strong signals.

Now about voltage and air on the 416B's. As far as electrode voltages go, this unit using the 416B tube was operated at reduced heater and plate potential. The heater voltage was set at from 5.0 to 5.3 volts ac, and the plate voltage was adjusted from 70 to 105 volts dc. At these values, it was found unnecessary to provide air on the seals of the 416B's, even though the cavity construction bottles up the tubes pretty much. All tubes tried worked well and the average plate current with cathode resistor values of 39 ohms, was on the order of 4 to 6 ma.

Increasing the heater voltage to 6.3 volts ac, and the plate voltage to the recommended maximum of 250 volts dc, did not make any useful difference in the received S/N ratio. Using such increased voltage will necessitate air blowing on the tubes. As previously stated, this may not be the ideal way to measure, but invariably whenever a weak signal was received with the lowered electrode voltages, raising the heater and plate voltage did nothing at all in a practical way of helping the received signal against received noise. Conversely, with the higher voltages and air on the tubes, the received signal was nulled by the antenna to where it was just copyable (CW)—then decreasing the voltages did not put the signal under the noise as might be expected. K5JHG also made this type of test and reports similar results. Only when one gets ahold of a really "flat" 416B does increasing the volt-



Modifications in red of original circuit to use the 8058 Nuvistor tubes.



Details of dimensions to construct the 8058 brass adaptor plates.

ages help the situation. As long as the tubes were drawing from 4 to 6 ma of plate current, the results were always the same as far as a practical QSO was concerned. No doubt the transconductance is lowered with lowered electrode voltages, but as stated earlier, the 416B is a pretty good tube, even working under such conditions.

Other questions were raised during the testing of this unit and one of these was the proper way to couple in with the antenna to the cathode element of the 432 mc tanks modified for the 416B tube. Checking the specs of the tube, it was found that the input capacity of the 416B is about 7.5 mmfd as against the 2.8 mmfd of the 2C40/446 type. Of course this will alter the original tuning characteristics and input impedance, and in an effort to get some kind of an answer, various tap positions were tried, starting at the ground end and working up towards the cathode point. Again using the 175 mile distant test signal and with the antenna nulled for the weakest possible CW

Table of tubes that might be available to 432 Mc hams

Tube Type	7768	416B	2C40	2C43	8058	6299	7077
Input capacitance in pf	6.0	7.5	2.8	2.8	6.0	3.5	1.9
Output capacitance in pf	.025	.0095	.02	.02	.046	.015	.010
Grid-Plate capacitance in pf	—	1.25	1.3	1.7	1.3	1.7	1.0
Transconductance in umo	50,000	50,000	5100	8000	12,400	15,000	10,000
Amp. Factor	225	300	36	48	70	115	80
Plate Resistance ohms	4500	6,000	6,860	6,000	5,600	9,600	9,000
N/F	4.5 db at 425 mc	3.0 at 400 mc 7.0 db at 1,300 mc	—	—	6.5 db at 450 mc	5.5 db at 450 mc	5.5 db at 450 mc
Freq. rating	—	To 4,000 Mc	To 3,370 mc	To 3,370 mc	To 1200 Mc	To 3,000 mc	To 1,200 mc

— Means unknown

signal, it was found that nothing was gained by tapping down the cathode lines towards the ground end. Invariably, the best S/N input coupling point was found to be right at the rf cathode connection of the tube. It is possible that a small variable capacitor inserted in the antenna lead may help in some cases, especially if some type of interference or spurious signal is present, but suca and arrangement really did nothing on the particular antenna and transmission line used at this location. If for some reason, it appears advisable to isolate the antenna, a 50 mmfd or more capacitor can be left in series with the antenna lead, but the system should be checked with and without the capacitor to determine if it degrades the S/N ratio.

Should the VSWR of the antenna-transmission line combination not be of the best, a re-entrant type of 432 mc resonant cavity will help in some cases.* This is inserted between the transmission line and the input to the 416B stage and could assist in offering the proper type of load to the input tube.

Under these conditions, then, it would appear that a broadly resonant 432 mc cathode circuit is about as good as one can do. As soon as the antenna is coupled in, attempts to actually tune such a broad input circuit with a small capacity element are of no avail.

Modification to 416B's

The photograph showing the 46ADT cathode tanks will reveal the changes to do the job. First off, the right hand tank is the unmodified component and it can be seen along with the original 446B tube in place in its plug-in-assembly. The tank on the left is the new 416B arrangement. This modification will necessitate a socket capable of accepting the 416B tube, which you will have to acquire along with the tube and presumably from the same source—and this new plug-in arrangement is to be made the same total length of the right hand unmodified unit. A piece of ¼" copper tubing with the end slit is used to make the difference in total length of the structure and will fit into the contacting fingers of the 446B receptacle. All the necessary rf chokes, cathode resistors, etc. can be fitted in the inserting socket shell as formerly.

Comparing further the two tank pots, it may also be seen that the silver-plated contacting fingers have been bent inwards on the left hand unit to perform a snug fit when the 416B tube is plugged in, and these fingers of course engage the rf cathode shell of the tube. Other changes will be the clipping out of the small

* See QST, February 1961, page 65.

2.0 mmfd ceramicon capacitor from the right hand unit, and the elimination of the two original cathode tuning discs, since the increased input capacitance of the 416B tube renders these unnecessary. Actually the left hand tank shows the variable disc still in but screwed back as far as possible. It is unnecessary and was later completely removed.

The last change concerns the input coupling tap. In the right hand unmodified tank, the antenna is tapped in close to the ground end of the cathode line. In the modified left hand unit, a new opening is drilled in the outer cylinder and the antenna coax input is secured to the rf cathode end of the line, as per the earlier discussion on the subject.

After these changes, the unit is rebolted to the chassis, power applied and plate circuits tuned. Nothing whatever is done to the output plate circuit located underneath the chassis. A slight returning of the plate control is all that is required. The 46ADT may be tested with this one modified rf tank or, if one desires, both rf stage tanks may be modified at one time and then rebolted to the unit for trial. Be sure to adjust the resistors in the plate circuit of the unit to produce the newly lowered plate voltage for the 416B's. Also take means to reduce the heater voltage on the two tubes to the lowered value previously given.

Results

A unit of this sort, using the two modified cathode tanks of the 46ADT was tested on a commercial broadcast STL link operating at 450.15 mc, ahead of a commercial GE receiver which used an 6AJ4 rf stage. The results were remarkable. A gain in excess of 20 db was expected and was achieved, but the improved S/N ratio of the received signal was impressive indeed.

Several hundred kilocycles of the band can be tuned before readjustment of the plate tuning is required. All in all, considerable improvement of the 416B's over the 446's will be immediately apparent.

Modifications Using the 8058's

Should the nuvistor 8058's be available to you and it is desired to utilize this tube type, proceed as follows:

First off, discard the two cathode tanks entirely. On second thought, do not discard but keep around for a quick comparison using the just modified 416B scheme. Merely unbolt from the 46ADT chassis. If you chose to disregard the 416B route, the original 446B tubes and tanks can also be bolted back and

tried at any time to get a comparison with the new 8058's.

W5QOA of Dallas dreamed up the following method for a simple and effective mechanical mounting to replace the 416B's or 2C40A's in the 46ADT. The idea here will be to construct a couple of adapters which will mount the 8058's and their necessary component parts and these adapters to plug into the plate circuit chassis holes left vacant by the removal of the two cathode tanks (L-601 and L-603). Two photographs are shown that should cover the details rather well. One photo shows the adapters before plugging in, and the other photo shows the adapters plugged in and operating.

To build the adapters, refer to the sketch showing details of dimensions. A couple of pieces of flat brass stock, 1¼ x ¾ inches and about 1/32" thick should be fashioned, as per the sketch, to mount the various components. These plates will then be soldered to brass rings or washers carrying proper dimension to allow the nuvistor sockets to be mounted therein.

The three necessary rf chokes, two capacitors and one resistor will all mount on each brass plate. RF input to the stages will arrive

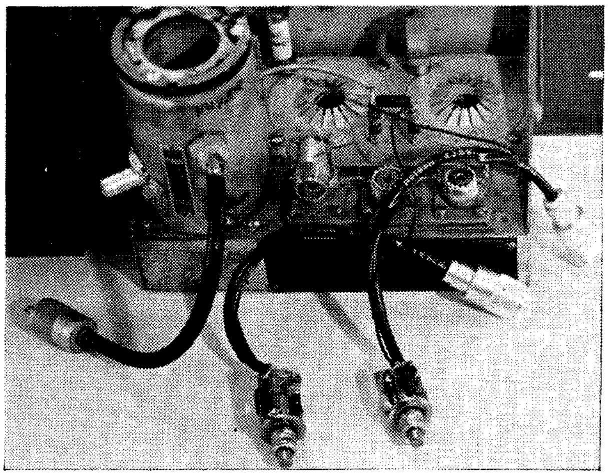
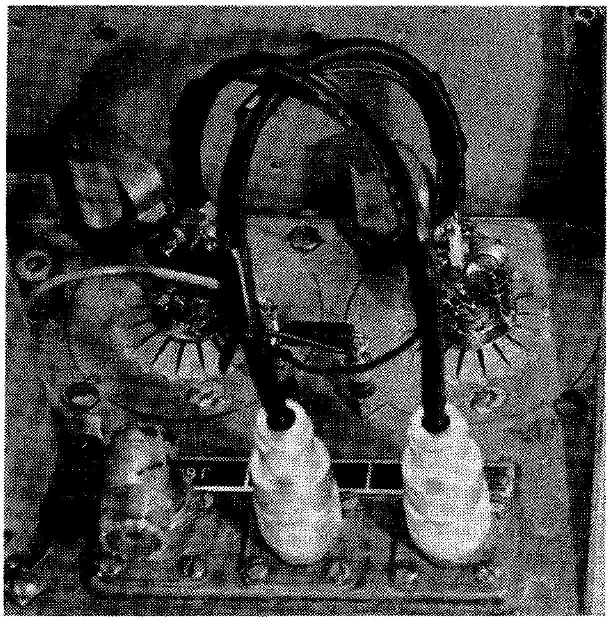


Photo showing the 8058 adaptors before plugging in the 46ADT chassis.
The two brass plates carrying the necessary components and the nuvistor sockets are visible. Also the silver-plated fingers on the grid grounding discs on the chassis can be seen to be bent upwards thereby effectively grounding the adaptors when they are plugged in.
The rf coming into the 1st stage is via the 8 inch length of RG-58/U and the rf coming into the second stage is via the same sort of deal.
The mixer in this photo is not used. This was to test the 2 rf stages only.
A couple of spring brass clips mounted on stand off insulators (up close to panel) are used to hold down the adaptors when they are plugged in.



This photo shows the 8058 adaptors plugged into the 46ADT chassis.
The silver-plated fingers of the grounding disc grounds the adapters (which grounds the grids of the 8058).
The spring brass clips or straps hold down the adapters firmly.

via a piece of RG-58/U coax cable about 8 inches long. Ordinary PL-259 type UHF plugs are used to connect to the chassis connectors of the 46ADT, as were the previous used tubes. Insulated tie-points on the brass plates provide means for mounting the parts.

The photograph showing the adapters unplugged will also reveal how the silver-plated fingers of the grid grounding discs on the chassis have been bent upwards a bit to firmly engage and ground the adapters holding the nuvistors sockets. A couple of spring brass strips mounted on the tops of the stand-off insulators are used to hold firmly down the adapters into the chassis holes. No shielding between the two 8058 stages will be necessary. Everything is stable. The two leads taped to the RG-58/U pieces of coax are the heater leads. No changes are necessary in the plate lines L-602 and L-604. The 8058 plate caps are the same diameter (¼") as the 2C40's or the copper tube extensions of the 416B's.

The series resistors in the plate supply leads should be chosen to allow 105 volts to feed the 8058 plates. Each tube will draw approximately 10 ma. The heater voltage should be the full 6.3 vac. No air is necessary on the tubes.

After the adapters are plugged in and power applied, retouch the plate tanks L-602 and L-604 for resonance and this will complete the job. The 8058's appear to be slow heaters, so it would be well to allow a few minutes warm

up time to take full advantage of the capabilities of the tubes.

These are smooth working bottles and should have quite long life. No difference in performance has been noted after more than six months service. The RCA tube manual lists the N/F of the 8058's at 450 mc as 6.5db. The only reference to noise figure of the 416B's at this frequency was furnished by W5LUU of San Antonio as 3.5 db. This was from an article in RCA Review for December 1958. To repeat; No practical difference could be noted between the two rf stages of 416B's and the two stages of 8058's. A listing of several types of tubes that are more or less available to UHF enthusiasts are listed. These are tabulated for rather rough comparisons and the information was collected from here and there. Additions or corrections to the list would be welcome.

Mikes, Handsets, Phones, Speakers

Gerry Stephens W9SLM
RR 2
Sheldon, Ill.

The following Specs were compiled to aid in the selection and use of various pieces of SURPLUS equipment.

Handsets

Type	Cord	Conductors	Plug	Remarks
TS- 9	9 ft.	3	terms	Unit includes PTT switch. Part of telephone EE-8.
TS-10	6 ft.	2	clips	2 sound powered phones in parallel. Impedance is 350-600 ohms. No PTT.
TS-11	6 ft.	4	PL106	Cord equipped with built in rf coil with PTT switch. Part of SCR-195.
TS-12	9 ft.	3	terms	Similar to TS-9 except has hanger to hook on box. Used with EE-91.
TS-13	5 ft.	4	PL-55 PL-68	Similar to TS-11 but has 750 ohm res.
TS-14	5 ft.	4	PL-204	Similar to TS-9 except no PTT switch. Part of SCR-561.
TS-15	5 ft.	4	PL-55 PL-68	Similar to TS-13. Different SW and no resistor. Part of SCR-300.
Type L	4½ ft.	2	——	Similar to TS-10 except impedance is 350 ohms.

Loudspeakers

Type	Impedance	Remarks
LS- 1	——	4" PM type, part of BC-603.
LS- 2	6	6" PM type in walnut cabinet. Part of SCR-13.
LS- 3	8000	6" PM type in 8 x 8 steel box. Part of SCR-299.
LS- 6	——	4" PM type with baffle and horn. Part of PA-4.
LS- 7	4000	4" PM type with input trans. 3 ft. cord.
LS- 9	250	Similar to LS-3 except lower impedance.
LS-11	250	Similar to LS-7 except lower impedance.

Mikes

Type	Res or Imped.	Plug	Remarks
			Hand held carbon, with PTT switch.
T-17	60	PL-68	Condensor type, with 2 stage preamp built in base. Part of GR-3.
T-21	——	——	
T-24	60	PL-106	Carbon mike, Part of headset SCR 194-195 and 543.
T-26	60	PL-58	Commercial telephone type carbon, with arm. Part of SCR-197.
T-30	120	PL-291	Carbon throat type, 2 units in series on neck piece.
T-32	40	——	Carbon mike on desk stand with PTT sw. Part of SCR-188A.
T-34A	200	PL-179 JK-26	Magnetic type, MC-233 mike. Part of SCR-522 and SCR-542.

T-35	75	PL-51	Similar to T-26. Part of chest set TD-1.
T-36	50	——	Carbon type with PTT SW. Part of PA system PA-4.
T-38	40	PL-58	Carbon mike with PTT SW. Part of SCR-197.
T-42	——	——	REPLACED by ANB-M-CL.
T-44	200	PL-179 JK-26	Magnetic type for use in oxygen mask. Part of SCR-522 and SCR-542.
T-45	60	PL-291	Carbon type, anti-noise lip mike.
T-50	21,000	Amphenol MC-3M	Moving coil type with PTT switch. Part SCR-299, SCR-300 and SCR-499.
ANB-M-C1	60	PL-291	Carbon type mike MC-254, may be used in T-17 and T-30. Replaces T-42.

Headsets (Phones)

Type	Imped.	Plug	Remarks
P -11	24 K	PL-5	Double receiver headset.
P -12	24 K	PL-5	Double receiver headset, will replace P-16.
P -13	512	PL-51	Double receiver headset with cushions.
P -14	24 K	PL-5	Double receiver headset with cushions. Part of SCR-189, 190, and 199.
P -16	24 K	PL-5	Similar to P-12 except has longer waterproof cord. Part of SCR-163.
P -18	24 K	PL-55	Similar to P-16 except different plug.
P -19	24 K	PL-55	Similar to P-14 and P-18 except has PL-55 plug and MC-114 cushions.
P -21	24 K	PL-55	4 Receivers on 2 headbands, one unit each headset in series. For 2 operators to listen to 2 different channels.
P -23	8000	PL-55	Double receiver headset with MC-162 cushions.
HS-16A	520	HB-1	Double receiver headset, used with code practice equipment.
HS-18	8000	PL-54	Fits crash helmets. 2 receivers with cushions. Replaced by HS-30 and HS-38.
HS-20	470	PL-55	Single receiver headset. Part of TG-5A and TG-5B.
HS-22	8000	PL-55	Double receiver headset, with cushions. Part of SCR-194.
HS-23	8000	PL-54	Double receiver headset. Replaced by HS-30 and HS-33.
HS-24	512	PL-58	Sound-powered type double receiver with cushions.
HS-29	256	PL-55	4 rcvrs on 2 headbands, used in DF installations.
HS-30	256	none	Double rcvr insert type. With ear inserts M-300.
HS-33	600	PL-354	Double rcvr headset with cushions MC-162.
HS-38	600	PL-354	Double rcvr for use in Air Corps helmets.

(W2NSD from page 4)

ers attached and be tuned up, plus hundreds of other major and minor details. As I was brooding over the amount of work to be done before the contest and my lack of time to do it, a couple fellows from the Waltham Radio Club dropped in and offered to set everything up in exchange for using the station during the contest. It was a deal.

Later on I hope to have our set up on the Mountain too, furnishing a TV signal of good strength nightly down through New York and New Jersey. We also expect to be set up on wide band FM on six, two and 420 mc. If we have enough visitors to help with hooking things up and operating we should keep the east coast fairly busy this summer on VHF's.

The Institute

While at the Dayton Hamvention I gave a talk about the Institute of Amateur Radio, explaining the basic reasons for its founding. I've expanded a bit on this talk and it will be found on page 92. One of the values of the Institute is that it puts pressure on the ARRL to do things that it otherwise might avoid. The sudden cooperation shown in the Santa Barbara and Denver legal cases when support was offered by the Institute are cases in point. Everyone has gained as a result of the Institute action.

Membership in the Institute is $10 per year . . . every cent accounted for and spent carefully for the benefit of amateur radio.

ARRL Board Meeting

The directors and officers of the ARRL gathered at Newington on May first. You'll read it in general in the June QST and in more particular in the extra fine print in July. Perhaps I can save you some time. Of the 52 motions placed before the board 47 were carried *unanimously,* two died of no seconding, one was withdrawn, one was tabled and *one* received one dissenting vote. Fabulous performance gentlemen. I sincerely hope that

(Turn to page 91)

Regulated Power Supplies

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As SSB grows in popularity, more and more of us are becoming exposed to regulated power supplies—an item once found only in the very well equipped laboratory. But not too many of us are actually familiar with just how these devices work, and the available literature does little to lift the fog.

Which is, in its way, no small pity—since the regulated power supply is a quite handy device for many purposes other than controlling screen voltage on a high-power linear! Typical characteristics of a good electronically regulated supply include the ability to set output voltage to whatever you want (within reason), fantastically low ripple (usually meassured in millivolts), and exceptionally low output impedance. These characteristics make such supplies almost perfect for VFO use, low-level audio, and of course general experimentation where a variable voltage is needed.

The one thing, apparently, which makes a regulated supply a bit difficult for many people to fully understand is simply the way in which they are usually drawn, and the unfamiliar terminology employed in talking about them. Let's start from scratch, building one up as we go, and see if we can't lift the fog.

The starting point is the circuit shown in Fig. 1; as you can see, it's an ordinary cathode follower, but is dc coupled throughout. It's almost obvious that the voltage across RL,

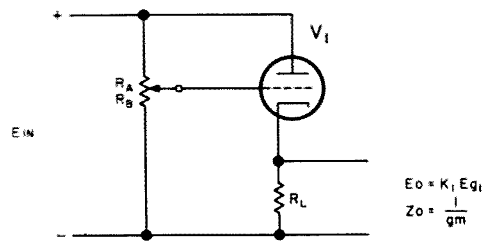

FIGURE 1

Cathode-follower "variator."

denoted on the drawing as Eo, will be equal to the voltage applied to the grid multiplied by the gain of the stage.

Cathode-follower gain, of course, is always less than one. A close approximation to the actual gain figure may be obtained by calculating the gain the tube would have under the same operating conditions but with the cathode resistor in the plate circuit instead, then using this gain figure in the formula: gain/(1 plus gain). The result, which will always be less than 1, will be the gain of the cathode follower. If "conventional gain" is as high as 9, cathode follower gain will be at least 0.9.

The circuit of Fig. 1 allows us to set the output voltage to almost anything we want, within limits. Since the tube gain will always be less than 1, obviously no setting of the grid pot will let us get more voltage out than we put in. Similarly, since the tube cannot be cut off by its own plate current, output voltage can never drop to zero. However, if we assume a constant gain of 0.9 for the tube and adjust the resistor from top (Ra equals zero) to midpoint (Ra equals Rb), and at the same time assume a 300 volt input, we can see that with Ra equal to zero we get an output of 270 volts, while with Ra equal to Rb we get an output of 135 volts.

Note that we are talking about *voltage* rather than power; this has an important additional effect. If our tube V1 can handle, say, 100 ma, we can control the voltage of this 100 ma current with a tiny replacement-grade volume control which by itself couldn't handle more than 5 to 10 ma!

Since this circuit, as shown, allows us to *vary* the output voltage at will we've dubbed it a "variator." However, it also provides a measure of regulation at the same time. Let's see how this can be:

You will notice that the output voltage is

taken from a cathode follower circuit. One of the major characteristics of a cathode follower is its low output impedance. This, in turn, is a way of saying that changes in load have little effect upon the output voltage of the cathode follower. But that last statement also describes a power supply with good regulation!

One of the more professional ways to measure or specify the regulating ability of a power supply is to specify its output impedance. So far as direct current is concerned, most ordinary supplies have fairly high output impedance. A voltage drop of 100 volts between no-load conditions and 100 ma drain represents an output impedance of 100/0.1 or 1000 ohms. But in practice, this would be a a pretty good HV supply!

The output impedance of the cathode follower, on the other hand, is approximately equal to 1 divided by the tube's transconductance. If the gm of the tube is 4,000 microhms, the output impedance would be 1/0.004 or 25 ohms. This is only 1/40 as great as the ordinary supply—which means 40 times better regulation.

But, though the simple circuit of Fig. 1 does provide adjustable output voltage and a

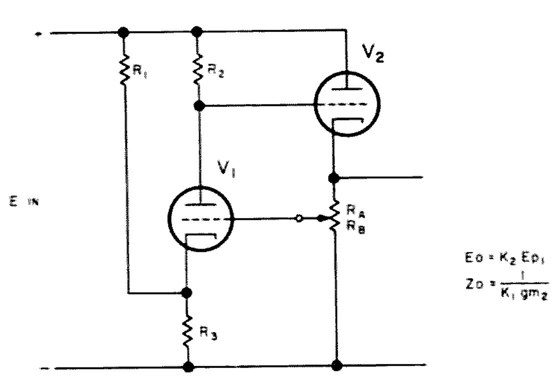

FIGURE 2

Transforming to become automatic "variator."

measure of regulation, it's not a true electronically regulated supply. Let's make it a little more automatic, and progress down the road to the fully regulated version.

A moment's thought will show you that the variable resistor made up of Ra and Rb in Fig. 1 could be replaced by a fixed resistor in series with a vacuum tube; variation of the tube's grid voltage would then change the effective value of Rb, and the result would be an effect identical to twisting the pot.

Fig. 2 shows how this substitution is made. V1 is substituted for Rb while R2 replaces Ra. The divider made up of R1 and R3 is a "stiff" bleeder designed to hold the cathode voltage of V1 at an approximately steady value. RL is now a pot instead of a fixed resistor as in Fig. 1, allowing us to set the standing grid voltage on V1 to any value we wish.

The output voltage, Eo, is still equal to the grid voltage on V2 multiplied by V2's gain; since the grid of V2 and the plate of V1 are tied together, any change of voltage on the grid of V1 will cause a corresponding change in output voltage.

But since an amplifying stage (V1) is involved, the direction of the change will be reversed. If V1's grid goes slightly positive from its starting value, current flow in V1 will increase, thus lowering the voltage at V1's plate and V2's grid, which will in turn reduce the current flow through V2, which ***reduces*** the positive voltage across Ra/Rb, minimizing the change in voltage at V1's grid (which started the whole chain).

This is a classic example of error-correcting feedback; any external action which tends to change the output voltage causes the feedback chain just described to become active, and the result is that the actual change in output voltage is held to a minimum.

The purpose of R1 and R3 holding the cathode at a fixed positive voltage is to provide a wider range of control. If the ratio of R1 and R3 is such that cathode voltage is, say, 105 volts, then the grid voltage set by Ra/Rb can vary either side of 105 volts. The net grid-cathode voltage, which is what determines current flow in V1, will be either positive or negative, depending on which side of 105 the grid voltage lies.

If the grid is at 100 volts, the net bias would be −5. Let's assume that this is the design point, and that V1 allows 1 ma of current to flow at a bias of −5. Let's also assume that we want an output voltage of 200, and that the gain of V2 is 0.9. Ein will be 350 volts.

For the output voltage to be 200 with V2's gain set at 0.9, we know the voltage at V2's grid must be 222¼ volts. For the grid voltage to be 222¼, we must drop 127¾ volts in R2. And we assumed 1 ma of current flow in V1 at the design point. This means that R2 should be 127,750 ohms; either a 120K or a 130K resistor would be fine.

For the voltage at V1's grid to be 100 when the output is 200, obviously Ra and Rb should be equal.

Now let's see what happens, since we didn't quite hit the proper value for R2 for practical purposes. If our regulation is working properly, the output should *still* be at 200.00 volts.

We start with 350 volts in, 120K at R2, and 1 ma of current through V1. This gives us 230 volts at the grid of V2, which we then multiply by 0.9 to get 207 volts out. Since Ra and Rb are equal, half of this 207 volts or 103.5 volts shows up at the grid of V1.

Subtracting V1's fixed cathode voltage of 105 volts from this 103.5 volts gives us a net grid bias on V1 of −1.5 volts instead of the −5 volts which fixes current through the tube at 1 ma. With less than half the bias, the tube's plate current starts to rise. But as it increases, the voltage drop through R2 increases also, reducing the voltage at the grid of V2 and consequently increasing the net bias.

For example, at the instant that V1's plate current is 1.01 ma, the drop through R2 is 121.2 volts, which leaves 228.8 volts at V2's grid. This makes the output voltage 205.92; V1's grid voltage becomes 102.96 volts, and the net bias on V1 is (102.96 − 105) or −2.04 volts. The 10 microampere increase in plate current has increased the net bias by 0.54 volts.

As the plate current continues to rise, the net bias rises with it; when plate current is 1.06 ma, the drop through R2 is 127.20 volts which leaves 222.8 volts at V2's grid. Resulting output voltage is 200.52, which results in a net bias on V1 of −4.74 volts. This value is very close to the design point; in practice, the plate

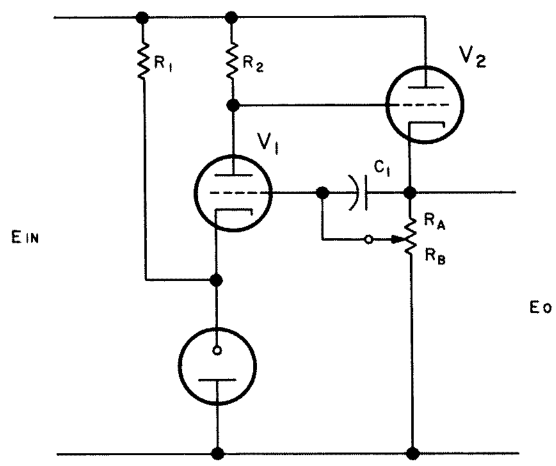

FIGURE 3

Two changes make it a regulator.

current would probably rise on to 1.06458 ma and give an output voltage of 200.01. For all practical purposes, the regulation is complete.

However, even the "automatic" circuit of Fig. 2 is not a fully regulated supply although it does regulate against any changes in *load.* If the source voltage rises by 10 percent, the output voltage will follow by the same percentage, because the *reference* used to determine net bias voltage on V1 is only a simple voltage divider.

Replacing R3 with a VR tube, to hold the reference voltage constant regardless of changes of line voltage or anything else, turns the circuit into a fully regulated supply. The change is shown in Fig. 3.

Another change is also incorporated in Fig. 3—the addition of capacitor C1. The purpose of this capacitor is to insure that any instantaneous change of output voltage (such as an ac signal or ripple on the line) goes into the correction loop at full strength rather than being attenuated in the voltage divider Ra/Rb.

The two changes together make the power supply output impedance virtually a short circuit so far as ac is concerned. If the output impedance of V2 alone is 25 ohms, and if V1's gain considered as a separate amplifier is 100 times, the output impedance of the circuit of Fig. 3 will be 25/100, or ¼ ohm! Even lower output impedances are attainable by using higher-gain amplifiers at V1; a super-gain cascode with gain of 2,000 here would result in output impedance of 0.0125 ohm.

In case you happen to be familiar with "conventional" feedback amplifiers, Fig. 4 is the circuit of Fig. 3 redrawn to emphasize the similarity with a feedback amplifier. Normally, the "amplifier" has no signal to amplify. If anything tends to change the output voltage, the change comes to the grid of V1 through Ra or C1 and since cathode voltage is fixed by the VR tube, this change becomes a signal to be amplified.

Amplification through a grounded-cathode amplifier inverts the phase of the "signal," while the cathode follower makes no additional change in the phase. Thus the amplified "signal" is effectively subtracted from the original change "signal" in the cathode circuit of V2; just as the remainder reaches zero, both "signals" disappear. Of course, as soon as they disappear the correction stops, so that the actual result is that the change is reduced by an amount equal to 1 divided by the product of the gains of each stage.

By this point, you should have a working knowledge of the concepts employed in electronically regulated power supplies. Here's how to use it to design one for your own needs.

First, of course, you must decide what output voltage and current you want. Then pick a tube (or tubes) for V2 which will pass the required current. The key characteristics of tubes for this position are high current-handling capability and high transconductance. Low-mu triodes designed for such service, such as the 6AS7 or 6080, are recommended.

Next, add to the output voltage an additional voltage to be dropped across V2, giving it something to work with. The usual allowance for V2 is 100 volts. This determines the supply voltage you need.

Now pick a tube for V1. High gain is wanted here; either triodes or pentodes are suitable. If pentodes are used, the screen-to-cathode voltage shoud be regulated with additional VR tubes. These VR tubes can be inserted in

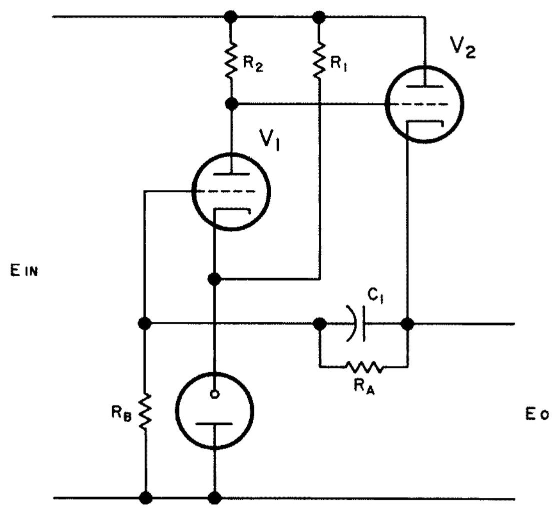

FIGURE 4

Fig. 3 redrawn to emphasize similarity to feedback amplifier.

series between R1 and the cathode in the circuit of Fig. 3.

The next step is to calculate the effective value of the minimum total load resistance for the cathode follower. This will be simply the output voltage (minimum if you're going to adjust it) divided by the maximum output current. Then use this value of R1 to determine the cathode-follower's minimum gain as described earlier.

Now divide the desired maximum output voltage by cathode-follower minimum gain just determined to fix the maximum voltage necessary at V2's grid. Also calculate the minimum voltage necessary at the grid of V2.

Knowing these two voltages, you can now pick a value for R2 which will allow V1 to be acting as an amplifier throughout the effective range. If R2 is calculated on the basis of only one output voltage, there's quite a risk of finding that you lose regulation outside a narrow range of output values!

From the characteristics of V1 and knowing the value of R2, you can quickly determine the net grid bias required on V1 at each end of the output range to produce the desired voltages at V2's grid. Subtracting these net bias values from the voltage of the cathode VR tube gives you the grid-to-ground voltage range for V1, which in turn leads directly to values for Ra and Rb. Frequently the Ra/Rb divider is made up of two fixed resistors with a comparatively small-value pot between, to give a bandspread effect; if you want to do this, calculate the resistors so that each end position of the pot gives you one of the extreme bias values.

And suddenly, at this point, you have completed the design. If you want an example to follow, go back to the sample circuit used to explain Fig. 2 and work it through.

Of course, this explanation and design procedure merely scratches the surface of the subject. A whole book could be—and has been—written about electronically regulated power supplies. But the principles described here hold true for any electronically regulated supply, and if you know them you won't have much trouble doping out any unexpected twists you come across. . . . K5JKX

FOREIGN SUBSCRIPTIONS

The foreign subscription rate to 73 is $4.00 U. S. per year, however we will accept cash or checks in foreign funds at the following rates:

Canada	$4.35	Germany	16 DM
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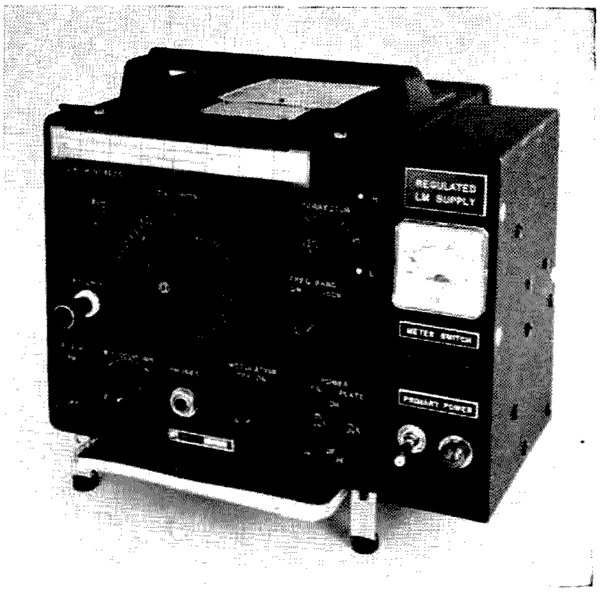
England	28/6	Spain	200 Ptas
Finland	14.2 FM	Sweden	20.80 SKr
France	20 NF	Switzerland	17.50 SFr

DX Titans Meet

Stuart Meyer W2GHK, on the right, talks with Gus Browning W4BPD on the left. Stu, president of Hammarlund, originated the DXpedition of the Month, a non-commercial program that has put on one extraordinarily successful DXpedition after another. It is getting a little difficult to find places to DXpedition these days because Gus has just about covered the entire earth, visiting 327 countries so far, including almost every bare rock sticking out of any ocean and well enough known for the ARRL to Classify it as a country.

Regulated Supply for the LM



Richard Arthur
1924 W. Farwell Ave.
Chicago 26, Illinois

Photo Credit: C. F. Cochran

The LM frequency meter, the Navy version of the BC-221, is still available on the surplus market and is a steal for the price being asked in comparison to the type and quality of instrument therein. John Meshna, Jr. is asking $49.00, in his current catalog, the lowest I've seen for many a moon.

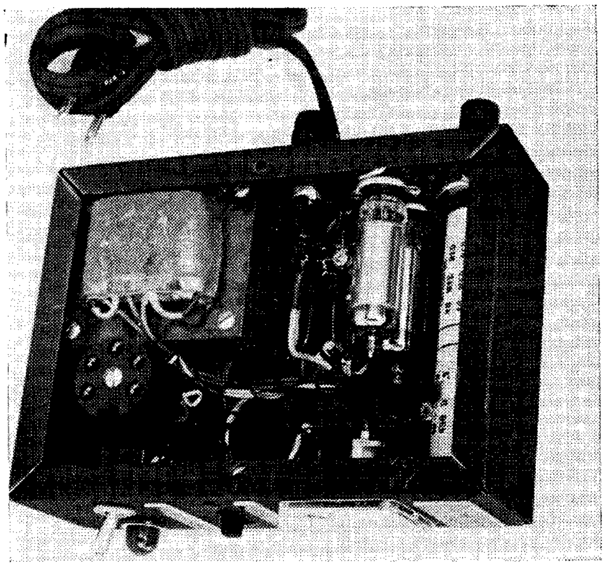
The LM covers a range of 125 kc thru 20,000 kc with crystal check points throughout its range. Many have used the harmonics with accuracy up to 150 mc. One advantage over some of the BC-221's is the addition of the internal modulation which is standard on all of the LM's.

Once you decide to lay out the fifty bucks or so, you have a nice "black-crackle box" but it isn't doing you any good without a power supply. There are several approaches to the power supply problem but the only right answer is to remember that you have a precision piece of gear, so therefore let's make a decent power supply to go along with it.

As seen in the photograph, the appearance of the attached supply adds to the general design of the LM. That it simply plugs in and out for servicing is a further beauty. No electrical changes were made to the unit itself, and only one mechanical change: that of removing the center guide pin from the power input connector. This is necessary, due to the fact that the mating plug in the power supply has been drilled out, countersunk, and a 6-32 flat-head bolt passed through it and secured to a metal spacer standing off from the cabinet.

The schematic is straightforward and should not present any problems in construction. If desired, the metering circuit may be left out in order to save a few bucks; however, I felt it was an asset to be able to monitor and know that the supply was delivering a regulated B-plus of 255 vdc.

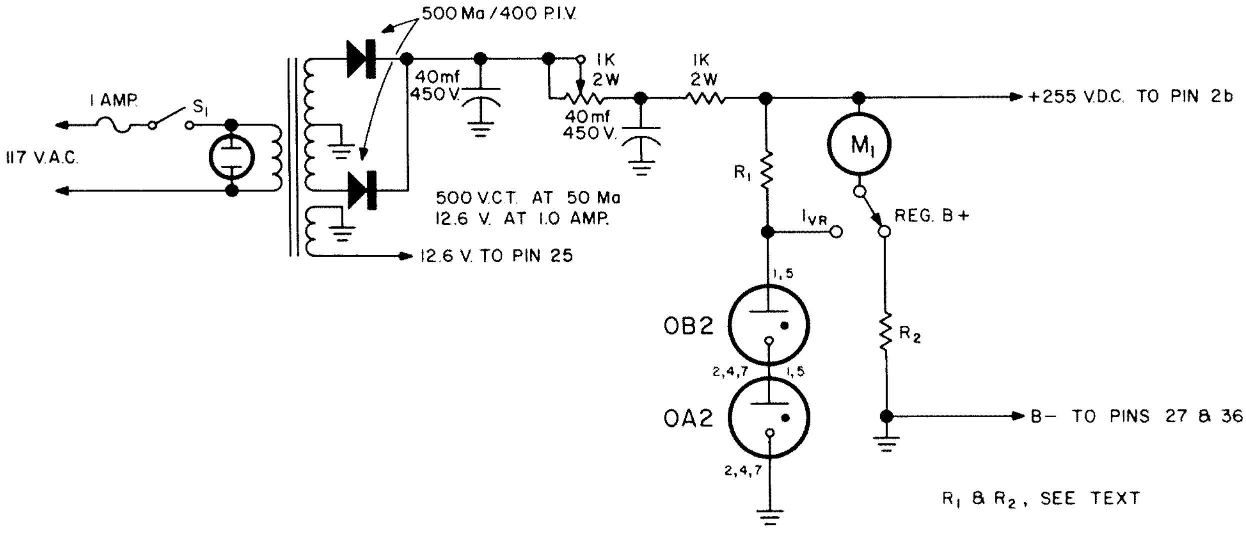
The transformer is available from GEMCO Electronics, 2415 S. Michigan Ave., Chicago 16, Illinois, for $2.69. They also carry the 1000 ohm, 2-watt control which is priced at $0.49. The cabinet is a Bud CB-628 chassis, which is steel in construction and comes with a black-crackle finish. It matches the LM finish closely. The meter is a Calrad CMO-38 which is basically a 1 ma meter with a 0-300 vdc scale. A 300K resistor (R-2) is furnished with the Calrad meter when purchased. R-1 is a shunt across the meter when the slide-switch is put in the left position, thus measuring the current through the voltage-regulator tubes. In my particular case, R-1 turned out to be 2.2 ohms to give a full-scale reading of 30 ma. This value may vary with meters depending upon the internal resistance of the movement. The reading on the meter in this



position should be about mid-scale indicating about 15 ma passing thru the VR tubes under load. This can be adjusted by varying the setting of the control mounted on the rear of the chassis.

Two five-lug terminals were mounted to the cabinet to provide connections for the two silicon rectifiers and the 1000-ohm, 2-watt resistor. The VR 7-pin sockets were mounted directly to the cabinet by forcing a 4-40 bolt through the center shield of the socket from the rear of the case. The pins of the socket were bent up to avoid shorts and provide ease in wiring. Three 6-32 × 2½" bolts were used to secure the power supply to the LM. Clearance holes were drilled through both sides of the power supply case to line up with the existing case holes of the LM. Therefore the long bolts pass through the power supply case and directly into the tapped case of the LM chassis. One additional hole was drilled and tapped into the LM case in order to secure the rear of the power supply. A handle was added to the top of the case. The legs were made by simply bending down the original locking brackets a full 90 degrees and attaching small rubber feet. The original feature of sliding the calibration book under the LM was retained.

Various articles have been written up on the operation and uses of Surplus Frequency Meters so I need not bother going into it at this time. All in all you will find the LM with the regulated supply to be a useful asset around the shack or bench, and a worthwhile investment.



Correction

Dear Wayne,

But like ouch! did I goof one up. I'm referring, of course, to "The Case of the Naughty Pi-Net." About all I can say in my defense is that to date not one of the guys who have written to point out specific mistakes have caught them all, but by now I'm getting a pretty good idea how mixed up it was.

Before I go into any detail, though, I have to re-emphasize that the major conclusion of that article is still correct. It's especially true in the 3.5 to 4 mc region, and on VHF, where it's the usual thing for a pi-net not to have quite enough range to take care of everything. Naturally, an antenna tuner is still the best answer, but some careful line pruning can work wonders.

Now to the biggest of the mistakes. I don't know which was the worst—getting it into my head that a full trip around a Smith Chart is a full wavelength (of course it's only a half wavelength, which in itself made all the column headings twice as large as they should have been), or trying to add and subtract impedances in parallel. To do this kind of cancellation, the impedances have to be converted to admittances for the calculations, then converted back to impedances for use.

The "circumference" error's major contribution to inaccuracy was, as I said, the change in line lengths involved. The other one, however, makes many of the numerical examples incorrect.

Still and all, even when worked out properly we find that at a point 13 electrical degrees either side of the starting point (minimum resistive impedance), the output capacitor of our pi-net operating on 7 mc must be about 1200 pf,

which while within range of most rigs is distinctly an abnormal situation. This is for a 2-to-1 SWR. Under the same conditions on 80 meters, the output capacitor would have to be 2400 pf, and it's seldom indeed that one this large is found in a rig. So I'll stand by my conclusions even if I did mis-chart my Smiths!

Thanks to the many fellows across the country who pointed out the circumference error, and to WB6HGC in particular who pointed out the error of adding parallel impedances. You can stop writing nasty notes now, gang. I know when I'm wrong!

And since, as I said, not one of the gang so far has caught *all* the mistakes in my use of the Smith chart, maybe I ought to write you a piece on "How to Use the Smith Chart." Believe me, I know how now—and we could invite all the fellows who caught the Pi-Net mistakes to check it over first, as well. What say?

Jim Kyle K5JKX

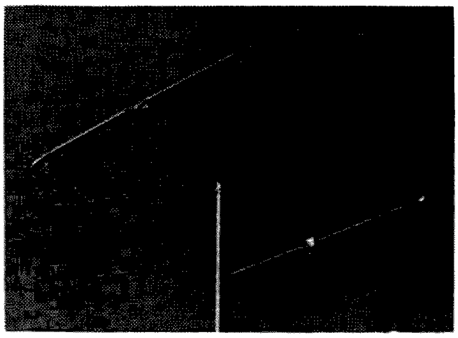
Hams in the News

LOS ANGELES: Lt. General Francis Griswold sent the folowing message from a military plane over the Pacific enroute from Washington to Honlulu: "I'd like to convey to all the amateurs the Government's sincere appreciation for the yoeman service in communications they have done in the Alaskan earthquake disaster. It has been terrific."

DETROIT: Nearly one hundred Michigan mobile hams assisted in a mass polio vaccine drive. With over 900 vaccine stations and an estimated 3½ milion persons getting the vaccine, communications was of extreme importance to see that supplies of vaccine were rushed to depleted stations.

INDIANAPOLIS. Pentagon radio operators said all contact with their Alaskan military bases had been cut off for over an hour after the quake. They asked any operators who gained contact to notify the Pentagon at once.

New Products



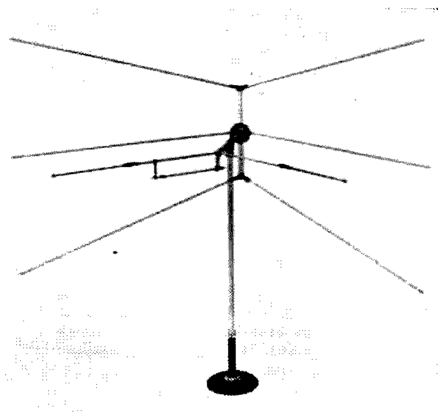
Squalo?

Yep, Cushcraft has invented a square halo. Models are available all the way from six meters right on up to 40 meters! The six and ten meter models are small enough to mount on top of a car and come with rubber suction cups for mounting. The Squalo has a 360° pattern with no deep nulls and is extremely compact. The 20 meter model, for instance, is only 100" square. This is about eight feet square instead of 32 feet long. The prices are very reasonable, the six meter model being only $12.50 and the 20 meter job $29.50. Cushcraft, 621 Hayward, Manchester, N. H.

B & W

Send a card right away for the new B & W catalog. They make a whole raft of things . . . miniductors, phase shift networks, pi-net inductors, coax switches, knobs, transmitter, linear, power supply, etc. B & W, Bristol, Penna.

Revealed at Dayton



One of the booths that was particularly hard to get into at the Dayton Hamvention was Newtronics'. The commotion had a lot to do with their first showing of their Coveya 6 beam. The Coveya is a combination of colinear, vee and yagi. Their specs say it has a 10 db gain over a dipole and 25 db front-to-back. It is gamma matched to 52 ohms and presents a VSWR of less than 2:1 over a full megacycle, which megacycle can be adjusted from 50-54 mc. The price is $39.90. You'd better take a look at this one, or send for a data sheet from New-Tronics, 3455 Vega Ave., Cleveland 9, Ohio.

Using the TS-118A/AP Wattmeter

Gordon Hopper W1MEG
75 Kendall Ave.
Framingham, Mass.

RF wattmeter TS-118A/AP is a portable load-resistor-type absorption wattmeter used for the measurement of rf power within the frequency range of 20 to 1400 mc. It is used with a selected thermocouple for power measurements, or is used without a thermocouple as a dummy load on these and lower frequencies.

The entire unit is housed in a metal case with a detachable cover and consists of the rf wattmeter, a tuning shunt, four thermocouples, three adapters, and an rf cable. There are four calibration curve charts, one for use with each thermocouple, attached to a cover which protects the meter face when the unit is not in use.

There are no operating controls on the wattmeter nor does it require any external source of power. Its meter is calibrated from 0 to 1 and indicates the output of the thermocouple. The meter reading is used to determine the power being measured and the four thermocouples cover a power range of 2 to 500 watts. The calibration charts are used to enable the operator to select the proper thermocouple.

Each calibration chart contains a K factor which are used in power calculations when used with the particular thermocouple indicated on its individual chart. This K factor is actually a representation of the maximum amount of power that each individual thermocouple is capable of handling. Each thermocouple has a C factor etched into it which is incorporated into the power measurement calculations. To measure a transmitter's output power, a simple formula is used. This formula is:

Power (watts) = K times C factor times meter reading.

An example of a power measurement is as follows:

1. Determine the transmitter's approximate power and frequency.
2. Determine from the charts the K factor for the approximate frequency.
3. Select the thermocouple whose K factor is closest to, but greater than, the approximate power. (The K factor can be equal to the approximate power.)
4. Assume that the transmitter frequency is 144 mc and that the approximate power output is 200 watts. Refer to the calibration charts and select the thermocouple whose K factor at 144 mc is greater than 200. If the approximate power is not known, use thermocouple MX-1783/U first.
5. If the transmitter output is terminated with a UHF or N type receptacle, connect the wattmeter as shown in Fig. 1.

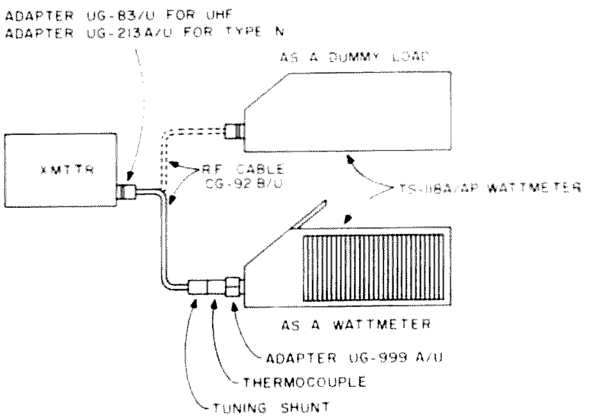


FIGURE 1

6. Note the correction, or C factor, that is marked on the thermocouple.

7. Turn the transmitter on and tune it using its own indicators, allowing one minute for the transmitter and the wattmeter to stabilize before taking a reading. (The wattmeter will lag slightly behind any power level changes.)

8. Take the wattmeter reading which will be 1.0 or some even hundredth part of 1.0 such as 0.84.

9. Calculate the power using the formula given previously:

W = 238 times	0.960 times	0.84
(K for MX-1782/U at 144 mc)	(C factor for MX-1782/U	(meter reading)

W= 191.92

Be sure to turn the transmitter off before opening any rf connections to the wattmeter. The power reading obtained indicates the power that the transmitter will deliver to a 50-ohm resistive load. Retuning of the transmitter will be necessary when it is reconnected to its antenna system.

If the TS-118A/AP is to be used only as a dummy load, connect it to the transmitter as shown in Fig. 1. It can be used as a dummy load in a 50-ohm coaxial line in the 20 to 1400 mc frequency range. However, it can also serve as a dummy load on frequencies below 20 mc by disconnecting meter M201 at jack J202. This will prevent the high vswr from damaging the meter.

. . . W1MEG

Modifying the BC-348

Harold Mohr K8ZHZ
5670 Taylor Road
Gahanna, Ohio

The 348 is a good stable receiver but is very hard to tune side band satisfactorily due to the tuning ratio of the dial.

First, obtain a small midget variable capacitor that has a shaft for a tuning knob. Then a 2 preferably, or not over a 3 mmfd ceramic capacitor. Remove the 2¼-inch by 6 inch metal panel that covers the rf tune sockets on the right front of the 348 panel. Remove all but one rotor and one stator plate from the small variable and mount it on the left of this panel cover. Make sure it does not interfere with anything in the tube socket compartment. You can place a small indication mark on the panel above the knob and place the knob in a straight upright position with the rotor plate of the variable condenser half in and half out of the stationary plate. This way you will be able to go plus or minus capacity.

You will find a wire running from the oscillator condenser (this is the gang nearest the center of the 348). You can solder one end of the 2 mmfd capacitor where this wire enters the oscillator coil, after you have clipped the capacitor lead wire rather short; then route a wire from the remaining capacitor lead to the stator of the midget variable. This is all there is to it.

You may notice that this will throw the dial calibration off about the width of the marker, especially on the higher bands, and if you are a perfectionist you can touch up the oscillator padders on WWV or some known standard, but be sure you leave the small capacitor with the knob in straight up position when doing this. Always leave it here and tune in the SSB or CW station the best you van on main dial with the bfo adjusted for best reception. Then you can go to the vernier knob of the small variable and tune in as easy as falling off a log. Leave the bfo set after you have found where it works best, and reduce the gain of the 348

if you have the gain and volume controls separated. If not, use as little gain as needed.

You will be able to listen to both sides of an SSB QSO, often by just adjusting the small capacitor. Then there is not any danger of losing the other station, as you will find you can tune most SSB signals in with AM quality by careful adjustment of this small capacitor.

Although especially designed for the BC 348, it should work as well with many other receivers.

. . . .K8ZHZ

(High Gain from page 33)

Like the previous circuit, this one makes use of an extremely high-valued plate load resistor. However, no shunt is necessary to keep transconductance up since pentodes maintain reasonable values of gm down to almost zero plate voltage.

The cathode resistor and bypass capacitor are eliminated by going to "contact-potential" bias for the grid, via a 2.2 meg resistor, while screen supply problems are bypassed by using a tap on the output stage's cathode resistor to supply the 10 volt screen potential necessary. Because of the high value of load resistor, which tends to limit current, and because cathode bias is used in the output stage, the grid of the 6AK6 can be direct-coupled to the plate of the amplifier.

This circuit has slightly lower gain than the super-gain cascode, but is still plenty hot. Its gain ranges from about 900 to 1500 depending on screen voltage and plate-supply potential. If more power is desired, you can substitute a 6AQ5 or a 6BQ5 for the 6AK6 shown. However, if 2 watts will suffice, the 6AK6 has a big advantage in its extremely low heater current requirement. As shown, the circuit requires only 35 ma at 6.3 volts on the heaters, and around 40 ma at 300 volts from the power supply.

Like the super-gain cascode, high-freqency response of the starved pentode is limited. However, it is plenty adequate up past 3 kc. To use the pentode with a dynamic mike, add a series capacitor between the mike and grid to prevent shorting out the bias voltage.

. . . K5JKX

Subscriptions

If you like 73 we'd appreciate your help in getting more fellows to subscribe. The big difficulty is to overcome inertia and actually get them to sit down to get it done. We try to make it as simple as possible on our end. The price is a simple (and low) $4. Our address is simple: 73, Peterborough, N. H.

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(W2NSD from page 75)

some sort of award can be made to Phil Spencer W5LDH of the Delta Division for chirping off key just for one instant at a board meeting. It has been a long time since that has happened. It's *something*.

Eight of the directors come up for re-election or replacement this year. How about it, shall we see if we can't get something in there besides a set of puppets?

OK, now let's see what the directors accomplished with those 47 unanimous votes. Hunty has been looking a bit peaked lately . . . I'll bet that handsome raise the board gave him will make up for a lot of the harassing he has been getting. The board gave the Executive Committe carte blanche to increase Budlong's "retirement" pay too. Hmmm, I understood that Bud was already getting 100% pay in "retirement," am I wrong?

Another big appropriation was $100,000 for the defense of amateur frequencies in the coming years. This is quite an appropriation . . . it is the dues of 40,000 members of the League, about one half of the members.

The hundred grand won't go very far if Hunty spends up a storm like he did back in 1959. He and Budlong represented the ARRL at the Geneva Conference that year and turned in a bill for $15,701.68, if I read the fine print on the League financial reports right. I don't like to bite the hand that has fed me (yes I do), but the dinner Bud and Hunty bought me in Geneva took care of my own ARRL membership dues for a number of years. I figure that I'm just making time payments on that dinner each year as I send in my check. Their hotel was palacial . . . the sitting room of their suit was larger than the lobby of my hotel. Nothing but the best . . . right?

Seems to me I remember their flying president Dosland over for a couple of weeks vacation. . . and didn't they pay his salary while he was taking time off his regular employment?

Shucks, there I go getting sarcastic again and I wanted to be straight forward this time. You'll have to admit that I passed up the opportunity to say something about the directors grabbing a ribbon for a dance around the May-pole. Well, I almost passed it up. I'll also not say anything about their dance around my February poll.

Seriously, is there any way that us members of ARRL can find out where this 100G goes to? If some good can be done with it, all the better fo us all . . . but we don't want it to turn into a big "fact finding" vacation fund.

. . . Wayne

What is the Institute?

1. Members
2. Directors
3. Coordinators
4. 73 Staff
5. Temporary secretary: Wayne Green

WHAT IS THE INSTITUTES' PROGRAM?

1. See that our legislators and government get publicity about amateur radio via the publication of a weekly newsletter.
2. A representative in Washington, Harry Longerich W2GQY/4.
3. Support amateurs in legal battles.
4. Establish club stations in new countries.
5. Sell ham radio world wide.
6. Get information on current events to all interested amateurs and IoAR members and encourage members to make their views known to ARRL directors and ARRL HQ.

Why is there a need for the IoAR?

1. Amateur radio has no representation in Washington.

a. Other users of radio frequencies have organizations in Washington to help protect their frequencies and privileges. See 73 April 64 page 18 for details. We, who have been the constant losers, more than any other group, should be strongly represented. We've tried doing without, can we learn?

b. Other hobbies have organizations in Washington to keep in touch with the government, and protect the privileges of the members against restrictive legislation and promote positive legislation. Good examples of this are the Aircraft Owners and Pilots Association and the National Rifle Association. AOPA, being on the spot, was able to get legislation through Congress quickly when they wanted alien pilots to be able to use their plane radios while in the U. S. Look how many years we've been trying to get reciprocal licensing.

c. The ARRL HQ group has been fighting a Washington office for years. There was considerable discussion of this in 1958 at the National Convention in Washington and the main reason against a Washington Office for the ARRL at that time was that HQ was convinced that such an office would grow quickly and would eventually overshadow the Connecticut HQ, forcing everyone to move to Washington. They didn't want to move.

d. The Institute of Amateur Radio will be centered in Washington DC. Four of the nine interim directors of the Institute are in the Washington area and they are proceeding with the bulk of the organizational work from there.

e. One of the IoAR interim directors is an official representative and is in touch with the Senate, Representatives of the administration, etc. The voice of amateur radio is being heard where it counts.

2. Nothing is being done to keep our own government behind us.

a. We had very little support at the 1959 Geneva Conference. U. S. delegates representing the various users of radio frequencies admitted that amateur radio was at the bottom of the list.

b. The ARRL has proposed no program whatever.

c. The Institute started in April sending a weekly newsletter to every U. S. Senator, every U. S. Representative, every state Governor and all Government officials involved with radio. This newsletter stresses the public service of amateur radio and the benefits to the country of our having a strong amateur service.

d. Government officials and Congressmen have an office to call when any problems come up regarding amateur radio. The Institute Washington representative has personal contact for all of us.

3. Little is being done to prepare for Geneva.

a. The outlook for the next frequency conference is indeed black for amateur radio at present. Educated estimates are that we will lose 40 meters plus parts of 80 and 20.

b. The ARRL has proposed no plan. It is depending on the IARU.

c. The IARU is in bad shape. It was flatly turned down in region 2 (North and South America) in April when president Hoover had no program to offer for saving our bands. Instead a separate organization was formed with separate officers. IARU region 3 (Australasia) is virtually unorganized. Region 1 (Europe & Africa) is partially organized, but may soon fall apart over lack of any program.

d. The Institute proposes to make club stations available to locals in DX countries who are trained in amateur radio by visiting DXpeditioners. This should help introduce radio

to newer countries. Several manufacturers have volunteered to supply equipment for this program.

e. The Institute plans to send out an international newsletter to government officials concerned with amateur radio to point out the advantages of having a strong amateur service. All probable delegates to the Geneva Conference will also get this newsletter.

4. Amateurs fighting legal battles get little support.

a. Whenever an amateur loses a legal case involving amateur radio this sets a precident which can then be pointed to in the future wherever a similar case is in contest. It is therefore of great importance for all precident setting cases to be won.

b. The ARRL provides legal advice, but not money. Legal cases can be very expensive. WØJRQ has spent well over $1500 fighting a suit against his tower. People that moved into his neighborhood well after he had his tower up have sued him for $8000 damages to the value of their property because of the unsightliness of his tower. If he loses this case every amateur in the country with a tower would live in fear of a law suit for thousands of dollars and with a precident for the suers to point to.

c. The Institute position is that cases like this are a responsibility of all of us and that funds should be provided to help amateurs who, through no fault of their own, have to fight a suit which could hurt all of us if lost. The Institute has sent $500 to help WØJRQ with his case. We understand that this has resulted in quite a change in the ARRL position and that there is a good possibility that the League's council may now be available to help flight the case. This is an additional benefit which wasn't planned for. With this array of support there is a good chance that the complainants may give up the case.

d. In Santa Barbara three hams have been prosecuted by the city as public nuisances to put them off the air. The entrance of the Institute into this case, we are informed, has again seen an offer of ARRL council Booth to fly out and help fight. We understand that the city, informed of this turn of events, has thought better of the suit.

e. The Institute is investigating the possibilities of providing all members with an insurance policy to protect them from suits connected with amateur radio. The Institute intends to help as much as possible amateurs with legal battles involving amateur radio.

5. There are at present no checks and balances for immence power of ARRL HQ.

a. ARRL admits that they do not represent the amateur (July 63 QST page 9, paragraph 4).

b. ARRL HQ suffers from frailities. 1) Irresponsible submission of RM-499. 2) Coca-Cola deal. 3) Santa Barbara legal battle 4) WØJRQ legal battle

c. It is much more difficult to succumb to frailties when you know that some group is watching your every move. Much more.

6. Little is being done to improve the technical standards of amateurs.

a. ARRL recognizes and decries the situation, yet has not furnished leadership.

b. The Institute proposes to establish a program of technical achievement with certificates and awards. 1) Exams to be given at hamfests and conventions under close supervision of clubs. 2) Awards for outstanding developments, break-throughs, unusual construction projects, patents, etc.

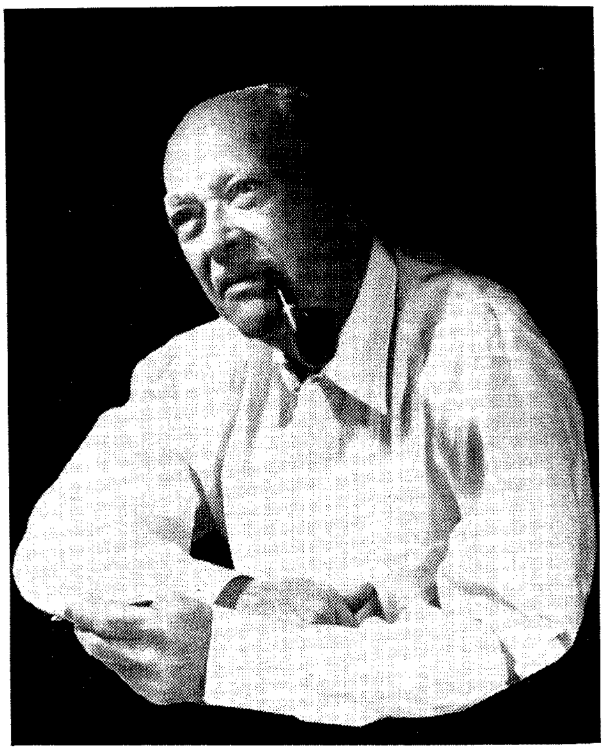
7. There is no organization program to keep commercials out of our bands.

a. Mount a full scale attack on elicit use of our bands by other services. Co-ordinate a serious effort to identify all transgressors. Lodge official complaints against them with our government, the ITU, the government of the country involved through their representatives in the U. S. and directly. Should this not get results we can muster the full strength of IoAR membership to put pressure on their government, their repersentatives in the U. S., their travel bureaus, etc. We will also let all the members of our own Congress know that the country is operating or condoning operation of transmitters contrary to international agreement through the ITU.

Interim Director W7OE

Howard Pyle W7OE. Age 66, licensed 1912, now Extra Class. Past calls: HP, MA, 7HP, 7NG, 7FT, 7OE, 7ASL, 8FT, 8RI, 8DAG. ARRL member since inception. Also member of SM, IAE; VWOA; OOTC; OTC; DeForest Pioneers; A-1 op; Morse Telegraph Club. Has had hundreds of articles published over the past 50 years plus six books, four of which are current. Retired Electronics Engineer with U. S. Gov't. Has worked as a sea-going merchant marine operator, marine coastal station operator and manager, 5 years Chief Radioman (permanent appt.) U. S. Navy, Chief Engineer several radio manufacturing com-

IoAR News



panies, manager RCA marine dept. Chicago, wholesale radio salesman, radio and later electronics engineer, U. S. Gov't. (2 depts.), Asst. U. S. Radio Inspector, Bureau of Navigation, etc. Charter and Founding member of IoAR.

Biography and Comments de K2TKN

It seems like a long time ago, and I guess it was . . .

A cousin came to spend the summer vacation. He was the same age as my brother and life became somewhat strained for me, being five years younger. This cousin was an electronics wizard, for altho only aged 12 or so, he had constructed a crystal set that actually worked.

After weeks of untold favors, cajolery, and outright bribery these two hooligans condescended to show little brother how to construct a set. A tightly wound coil of wire on a cardboard tube of well-known but unmentionable origin, manufacture of a sulpher and lead crystal, and trading him out of his spare headphone (as I recall, my soul was only a small concession in the deal) and I was the proud possessor of the finest crystal set in Kansas City that stoutly refused to utter even a faint squeal. Long weeks were spent that summer, winding and rewinding that coil, carefully scraping a path for the slide tuner to contact, all under the close supervision of this radio whiz kid. Noth'in . . . Not the faintest sound. He went back to Des Moines and school and after several months more of fruitless effort my brother let slip that that tightly wound coil of mine was bare wire while the working model had enamel insulation. After 30 years I do occasionally speak to my brother again. In spite of his perversity, the cousin went on to become W9TGL (three gorgous ladies) of pre-WW2 fame and today is a slightly tarnished BRASS HAT in the AIR FORCE who has been known to get on the air as W4WGO. After what seemed eons at the time, I recall learning the code at government expense. This consisted of religiously taking the amateur tests every time the FCC inspector came to town with his tape machine, always flunking but each time by a little less, meanwhile frantically bootlegging on 160 meter fone far into every night. To this day, I am sure that kindly inspector (MacDonald) overlooked an uncrossed T or misplaced punctuation mark to get me 65 in a row and out of his hair, or off 160, I am not sure which.

What a thrill to legally call CQ and hear an answer—Ollie W9EKJ who was clear across town was in there loud and clear. He promptly, with some knowledge of prior operation, demanded that I get off the air and quit using his call—refusing to listen to my attempts at phonetics to explain my call was plainly W9ETJ on my license and he went clear ape when my buddy George Horner, who had received his ticket that day also, called in with W9EDJ. Half the whole 160 meter was in that ruckus before the air cleared that night. Shortly after, I was intiated into the business side of this game, chasing parts at Van Sickle Radio, St. Louis for Griff W9OWD, God rest his soul. I am sure he and Walter Ashe gave more young squirts their start in this business than all the DeForrests, Sarnoff's, etc., put together. And Walter is still doing it.

Wells Chapin W9DUD was building some of the biggest and prettiest KW rigs ever known by the late '30's. I know, for he used to come into the store and buy a $1.19 17 x 13 x 4 steel chassis, they didn't come any bigger and my job was to punch out the holes he drew on the brown paper cover. Try going into the parts house today, buy a chassis and ask them to punch the holes for you (HA) and all we had in those days were Greenlee hammer punches. Thats what the part-time after school amateur kids working there were for. After working there several years, the Naval Reserve was called out and I got out of High School concurrently in early 1941. That free crystal cost me 5 years in the Navy. As I recall, I owed Griff about $3000 for parts purchased

at employee discount above my wages, which he had tallied every week then written off as a dead loss. I had DXCC before I found out boys were supposed to go out with girls and had collected several Grand Island FCC QSL's for shorting out the only choke in the PWR supply on my push-pull parallel TW-150's after a W6 let slip how to get that sure fire bat of 120 cycle gargle that no DX on the low end of twenty could resist. If there hadn't been plenty of science courses and a ham as principal of the school, it couldn't have been done. In those days, OM, DX was pure work. They hadn't been Gus'ized, Danny'ized or Collins'ized and neither had we.

By 1946, an old grizzled hash-marked Chief Radio Technician was let out to pasture, after all he had been thru every radio and radar tech school they had and then several years of too many TBM-TBK, SA, SC, SQ, SG, over two hundred SJ's each with cronic problems someone had to suffer with. I was 22, but felt everyday of 100. One bright spot stands out in my memory of those days. One Christmas eve when I had the duty at the RMO 15th Naval District Panama and after finishing straightening out the bumps in the linoleum of the radio shack floor or some other highly secret technical detail transit ships demanded the base experts attend to while the crew bellied up in RioBahoo, some other disfranchised ham and I were sitting there sloppin up coffee and discussing the hell of being in DX country at such a time. This was in the radio shack of a tin-can, I believe, and there was a TBK transmitter with the filaments lit, tuned up at a full gallon on 8120 kc or such. Deciding they could only shoot you once, I let out a long slow CQ DX and signed W9ETJ. This was 1944 when we were not exactly winning the war in the Pacific and there hadn't been a legal Amateur contact since 1941. The band opened up for 20 kc either side with the ##$'"&# pile-up of DX ever packed in at one time in the history of radio. For the next two hours we worked'em by the gross. There were Japs, Germans, Iti's, Russians and Allies by the numbers. On the frequency, that night before Xmas, there were just Amateurs, doing what they like best—there just wasn't any war for us for abt two hours. Half the GI's were too chicken to sign their own calls and used initials, etc.—it sounded like 75 meters the night before we got the band back after the war. Finally, someone decided this amateur bit was not the way to fight a war, and NSS cranked up on frequency and demanded identifiers which rather squelched the whole thing. At noon the next day, there were still a couple of PY's working J's for WAC on the frequency. The fact that Boyd Phelps W9BP was RMO may have helped keep in out of the brig.

By 1950, after deciding there had to be better ways of making a living than AM soap-radio engineering including owning a peanut-whistle, KXGI, and going thru the BOOM TV shop periods, I ended up a field engineer with Raytheon Mfg., Chicago. Six hundred and fifty service meetings later moved over to the Magnecord and sales. By this time, WØETJ out of Elsberry Mo. had done fairly well on six and two. That five or six miles west of the Mississippi river sure made that an ideal location. Being the first WØ going west when six and two were new was some pumpkins, I'll tell you. There were more than numerous occasions when Dallas W9AAG, Red W9EHX, W9MUD and many other W9's in western Illinois sat there and heard W1, 2, 3, 4's calling and at times working that ### Ø just over the line. Before leaving, a 25 ft. cylindrical parabola 70 feet in the air had effectively removed about two states from the distance to the East Coast. W2AZL and W2CXY still claim I must have been using that xtal set with the bare wire coil but the 4-125's at 4 KV and 1 amp put out a fair signal after little taming, and care not to make long dashes. Don't get out your slide rule to figure out the input—that was the most legal KW ever generated to snag DX on two. If you held the key down long enough for the meters to slow down long enough to read, those 4-125's would have been walking around the ceiling of the shack.

Ten years ago, Ed WØLFE, inherited the favored WØ position and has done very well for himself, while I am in the middle of the gibbest pile of locals on VHF in the world. The band could be wide open to W6 on two from New Jersey and the call K2TKN and 10 cents would get me a bad cup of coffee under the pile-ups. There was nothing else to do but go on 1296 mc to find some elbow-room. I find there is plenty.

An old man from up the road, after looking at the 20 ft parabola and other contraptions cluttering up the QTH and learning I point these at the moon on occasion, asked "But what does the Moon say" and you know he may be right. There sure isn't much of a QRM problem.

Being a gadgeteer by nature, VHF and UHF have always fascinated me for here are vast areas of uncluttered space where an untutored amateur, by the expedient of extreme specialization and simply wanting to do something of value badly enough, can make monkeys out of

the communication "experts." We've got receivers now that make their Kilobuck specials about equal to xtal sets and we have always been willing to try anything. They can't get a contract from the Gov. unless their theory looks right. We can't lose, all we have to do is play the cards. They may have been stacked in our favor up in this range of frequencies.

Below 100 mc, I am afraid it is another story. The majority of my actual operating time in the DC bands recently has been on Air Force MARS channels. If you would like to fully understand what the HF amateur bands are going to sound like shortly at the present descent levels, try copying SSB traffic on 3295 kc at 0200 Z or 7460 kc. These are military channels with the full authority of the US backing them up and this makes them open season for every raw ac crud generator in this hemisphere. Reread W4LCY article in May 73—then read it again and see that every meeting of your local beer-chowder club is devoted to actually what can be done. Let someone else win field day, for at the present rate of descent there aren't going to be many more anyway.

I am a lousy commercial—I make a living selling Cornell Dubilier products to the parts distributors that sell to amateurs. Loss of the HF amateurs bands or incentive louse-up would mean reduced HAM-M and TR-44 rotor sales. (It already has in truth.) That would only leave less than 28,000 other items for CD to sell to the distributor whose amateur sales dollars are a small part of his total. You don't seriously believe the amateur sales of Collins, Hallicrafters, etc., keep these companies in business, do you—this isn't 1938—it is pretty late in 1964. And if you don't think I know this market and how to peddle merchandise, reread the sub-liminal (free) ad built into the second sentence of this paragraph. Bill Orr and his group of old pro's couldn't have done better in QST. Which reminds me, you couldn't buy my ARRL membership for kilobucks during this hassel. I've found as a mem- I am entitled to vote now and then. It isn't for much, but few bothered in the past so who cared? I've had go-rounds with Headquarters before about raw commercialism in QST and their lack of interest in 432 mcs when we needed it most, and found them subject to the same human frailities as most. Pressure on a Director who in turn does a little desk-pounding has it's effect. I like to remember copying code practice on a one-tube blooper and the thrill of W1AW's big signal in the middle-west a long time ago, but as I have gotten older and a bit more experienced in worldly ways, I'm afraid the ARRL doesn't have the same image it once did for me. As a commercial corp. they would bumble along making large noises of extremely conservative gooble-de-gook til the first highly specialized, market and cost conscious—sales oriented competitor took them to the cleaners by the chapter and verse. The crime in this case is that *you* are going to lose forty meters and large chunks of the other HF bands while *we* try to straighten out our internal organization. Everything is new at Headquarters except the direction and point of view. The outpourings and apparent objectives seem about ten years old.

Our first preliminary organizational meeting of IoAR directors was, by necessity, in regard to immediate and extremely necessary actions and short range objectives. A great deal was said about the average amateur and what they could do, given the opportunity, to keep what they own. I didn't say much, for I was in complete agreement with what was being said. But, after the meeting, when driving home, I had a chance to sort out the multitude of thoughts proposed by this keenly and currently aware group. It suddenly struck me. . . I have never met an *average amateur.* I'm not average, and you're not either. If I was, I wouldn't admit it, and anyone that says I am is in for a very hard time. As sure as I am sitting here looking for the erase key on this mill, my ARRL director has me lumped up with all the other K2's and he tries his best to represent this image. No wonder things are in such a mess. And if this is true, the HdQtrs people must think of the average director and his views as representitive when making daily decisions that affect everyone of us . . . My God—I'd rather eat a can of worms than picture that, but it is true, and it has been going on for years.

But that is democratic government, you state. Not by a long shot, not in professional politics in modern times. We live in the best country in the world today because a finely balanced set of check and counter checks have developed at all levels, individual, ward, city, county, state, and national, keeping everyone aware of current situations and on their toes. The very intricate system of lobbying at all levels of government, from your local school board to congress, is an extremely important part of this system of government that we are justly proud of. I'll guarantee you are not first in line waiting to vote in some local or even national election, but even a hint of increased property tax will put you firmly up front pounding the desk of your alderman or town council member, etc. I've never heard of a lob-

by in Washington actually representing me as a US citizen, but there are hundreds of them representing in fine detail every facet of my every day action, each highly specialized in a certain field. This I can understand and now it is apparent to me how IoAR can provide an aggressive and healthy additional service to every amateur. Just keep in mind that each of us is an individual with divergent views, pet-peeves, and care-less's. If you don't think so just ask your wife—I wouldn't dare ask mine!

Let me illustrate my point. You are a paid-up member of IoAR and without your individual approval, I am a temporary director of IoAR. I am professionally employed in electronic industry, an advertizer and paid-up member of ARRL-QST and am going to stay that way. That lost about 25% of you. I think we are too little and too late and am sure we are going to lose much of our HF bands in the next few years, and think we are getting just what we deserve for lack of effort. That alienated another 50% right there. DUD just flipped. My opinions on how to clean up the HF bands are well known by some, but in particular by the FCC. My petition to them, countering the ARRL foolishness, makes operation on any mode on any HF band a privilege that must be earned by each individual amateur by personal effort to expand our knowledge of VHF-UHF, by extended occupancy thereof with state-of-the art equipment, homebrew, kit or appliance. Try to DX-country hop and keep your HF privileges under these conditions. If you think I'm kidding just forward SAS plus for duplicating cost and you can read a copy of this bomb. That eliminated most of the rest, but just to make sure, many individuals and clubs have heard me expound on why Technicians should be re-newed after the 1st five year period by formal office exam, only and that the conditional situation stinks to high heaven. Wow!

I do believe that VHF-UHF expansion is our only hope, that a few thousand experienced adult-oriented (no grandfather clause crutches) HF stations can handle 10 times the true emergency possible in the trivia current today, and would present an image to the rest of the world that would help us expand amateur radio, rather than destroy what we all love and wish to preserve, *as is now happening*. I think that the most important single quality of Amateur radio is that you transmit only if you desire, say only what you want about your views, circumstance, convictions or color and can shut off the rcvr and hit the sack at *your* convenience. There has never been a social precident similar in history and any personal effort on our part is well spent to preserve it.

I am sure you do not want me standing up representing your personal interest in amateur radio, for these aren't your likes and desires.

This is precisely my point.

IoAR is composed of individual members and there is no reason each cannot actively but even several thousand individual cries in promote and lobby for his particular specialty, the wilderness have no effect without some form of co-ordination. Whether by design or fate, each of the temporary directors in IoAR is fairly specialized in sphere of influence and personal interest.

I propose that IoAR become the most vocal stridently-insistant lobby in the amateur world. Guided by direction and suggestion of the directors, each in his own special interests, thru our own channels and the pages for IoAR in 73 each month, each member should direct one personal message per month to his ARRL Director, a personal message to the home address of John Huntoon or other salaried employee of the League, and one to the most appropriate Washington address indicated by current information. Not by mail, after all we have a fantastic communication system in amateur radio. Can you imagine the result in these comic strip nets on 80 CW when 10,000 30 to 50 group messages hit the NCS. After they give up, we will handle them on IoAR relay. For the first time, RTTY and plenty of it is a necessity. Here is an opportunity for a traffic organization that people will wait in line to join. If you think the Military won't suddently be interested in this type of operation, think again. The possibilities and complexities could only be handled by amateur radio. Each individual IoAR member can represent himself, or abstain from any issue. Each Director represents special amateur interests, not geography or mass, acting as a focal point and director of attention.

For some reason I have an idea that thought of mail or phone calls around Hdqtrs isn't going to be popular discussion, for the next few years. Just to keep those lovely secretaries busy, every member should write and ask one detailed technical question in regard to any current QST tinker-toy project every month. I have never known a group that talks as much and says so little as the US Amateurs, but if each reserved just 150 well chosen words a month and directed them in certain directions, mountains wouldn't move they would run.

1964 Special Surplus Catalog Section

Our special surplus issue last year brought so many compliments that we thought we'd bring it up to date. We've been using the catalog section quite a bit here at 73, but then I'm a surplus nut, as anyone can verify that has seen our barn.

There was a time when I darned near swore off surplus. It was right after the war when the War Assets Administration was giving large lumps of surplus to schools that would accept them. Well, imagine my delight when an SCR-547 turned up in the vacant lot next to my school. As president of the radio club I could see where we had some fun ahead of us trying to convert that into something useful. We tried to get some official action from the school on the thing, but couldn't find anyone to accept the responsibility. We got more and more frantic about it as the local kids played war with it, using the tubes for grenades and smashing everything breakable. Finally, in desperation, four of us rescued the remains for the club. This brought officialdom to life. The school decided that everything would be alright if we paid for the parts destroyed by the local kids. It was a bitter pill for us, but we paid. Somehow I've never encouraged anyone to go to that school since then.

I've been buying surplus again so I guess the wound has healed. We're busy converting APX-6's, AXT's and ART's for 432 and RDP's for watching the UHF bands for activity. We've got a surplus TV camera chain and some wide band FM gear. We hope to have all of this working from 73 mountain this summer.

Surplus has done a lot for ham radio. Where would two meters have been if the SCR-522 hadn't been available in huge inexpensive quantities? Thousands of them were put on the air. I wonder if the original Gonset Communicator would have made it if there hadn't been all those 522's around? I'm still using a 522 as a driver for my high power rig on two meters . . . the final is a piece of surplus too (Herbach and Rademan $29.50). How many of you have *not* converted an SCR-274? Not many.

I buy surplus because I am a cheapskate and I want to get the most hamming with the least dollar investment. The following pages represent a pretty fair catalog of the surplus that is available today in all parts of the country. It is a lot easier to read it here than to try to visit Boston, New York, Ohio, Chicago and Los Angeles . . . and most of these fellows don't have time to put out a catalog.

Radar Principles-Simplified

Gordon Hopper W1MEG

Although radar is not one of the forms of communication generally used by radio amateurs, the author feels that amateurs should have a "speaking acquaintance" with this very important and fascinating phase of electronics. Possibly reading this article may capture your interest enough to cause you to investigate in detail what makes a radar "tick." In any case, we hope that this article will clear up some of the questions you may have had about radar.

Introduction

The word RADAR is made up by extractions from the phrase "RAdio Detection and Ranging." Basically, radar is the application of radio principles to detect unseen objects and to determine their direction and range. In special types of radar, elevation and speed may be inicated also.

Radar is one of the greatest scientific developments to come out of World War 2. Its basic principles are relatively simple, and the seemingly complicated circuits can be resolved into a series of functions that, when taken individually, will afford identification and unlerstanding.

Basic Principles

The basic principle of radar operation is dependent on creating (transmitting) and pickng up (receiving) an echo. A radar transmiter emits powerful, short bursts of rf energy. Some of this energy will strike objects within he range of the transmitted signal and be eflected back to the radar receiver. It is posible to determine the distance of the object ausing the reflected signal to return by careully measuring the time required for the nergy to go to the object and to return, and hen translating this information into a measire of distance.

Sound echoes or wave reflection is the rinciple used in radar operation. If a person houts in the direction of a sound-reflecting urface 2200 feet away, he will hear his shout eturn in about 4 seconds. If a directional device was built to transmit and receive sound, the principles of echo and a knowledge of sound velocity could be used to determine the distance, the height, and the direction of an unseen object.

All radar sets work on principles much like these in the preceding paragraph except that a radio wave of extremely high frequency is used instead of a sound wave. The radar set transmits a short pulse of rf energy and receives its own echo signal, then transmits another pulse and receives these echoes. Depending on the design of the radar set, this cycle is repeated 60 to 4000 times each second. If the energy is sent into clear space, there will naturally be no returning echoes and the energy is lost. If the energy strikes an object such as a building, ship, airplane, or hill, some of the energy will be reflected back to the radar's antenna and receiver. If the object is large, a strong echo (but only a fraction of the radiated energy) is returned to the antenna. If the object is small, the echo will be weak. Radar waves travel at the speed of light, approximately 186,000 land miles per second or approximately 162,000 nautical miles per second. Radar signals have been directed to the moon and their echoes have been received approximately 2½ seconds later.

Because radar utilizes the uhf and the shf bands, the energy will travel in a straight line with very little effect from the earth's atmosphere. Consequently, there is a very short time interval between the transmission of a radar pulse and the reception of its echo. It is possible to measure the amount of elapsed time to an accuracy of one ten-millionth of one second (1×10^{-7} seconds). The forming, timing, and presentation of these pulses are accomplished by special circuitry and devices.

The antennas used by a radar set are designed with a sharply defined beam. When a signal is being received, the antenna will be rotated until the received signal is maximum. The direction of the target (object) is then determined by the position of the antenna.

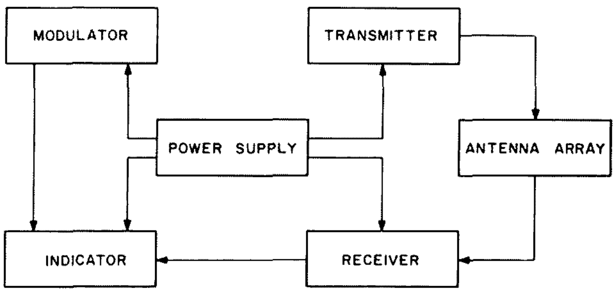


FIGURE I

Fundamental elements of a radar system

The echoes received by the radar receiver are observed on an oscilloscope (built as part of the radar) as marks of light. This scope may be calibrated in miles, yards, or degrees. A radar operator can tell the bearing and range of a target by the position of the echo on the scope indicator.

Azimuth is the relative horizontal direction of a target with respect to some particular direction reference expressed in degrees. Elevation expresses the angular degrees that the target is above or below the radar set. Both azimuth and elevation must be considered in determining the direction of a target. The determination of both azimuth and elevation depend upon the directional characteristics of the radar antenna.

Types of Radar Systems

There are several radar systems in current use, each with major differences between them. They are the frequency modulation system, the frequency shift system, and the pulse modulation system (most commonly used today.)

Frequency Modulation System. Because each cycle of a frequency-modulated wave differs by a small increase in frequency from the others of that wave, a frequency-modulation system makes it possible to identify each cycle of the transmitted wave and to recognize it from all others when it returns to the receiver. If a transmitter is designed to produce a signal which regularly changes over a known range of frequencies, it is possible to identify any particular reflected signal cycle. Two separate signals are fed to the receiver and, when mixed, produce a beat note. The frequency of the beat note varies directly with the distance to the object, increasing as the distance increases. A device that measures frequency can be calibrated to indicate range (distance to object). A measurement of the difference in frequency between the transmitted and reflected energy determines the presence and speed of a moving target. The frequency-modulation system works well with stationary or slow-moving targets but not as well with fast-moving targets.

Frequency Shift System. This is based on the Doppler effect. If the source of radio energy (an aircraft from which radio waves are reflected) is moving rapidly, the frequency of the echo return signal will change provided that the object is moving toward or away from the receiving antenna. The circling of an aircraft (or cross-wise movement) will not change the frequency. The amount of frequency change is proportional to the speed at which the object is moving toward or away from the receiving point. The detector in the receiver responds to the difference in frequency. If the object is not moving, or if it is moving crosswise, the detector response is zero. In a mountainous area where the echo return signals are stronger than the echo return signals from an aircraft, the frequency shift principle is sometimes combined with a pulsed radar system. The moving objects are differentiated from the stationary ones, the stationary objects are eliminated, and the operator sees only the moving objects. In this type of system, the frequency shift detector device is supplementary equipment attached to the radar set and is called a moving target indicator.

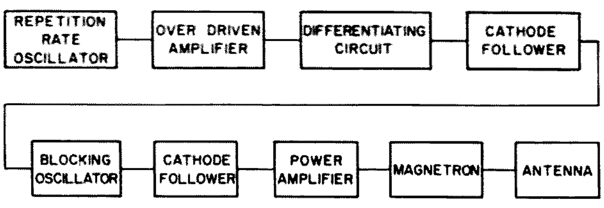


FIGURE 2
Simplified block diagram of a modulator and Transmitter

Pulse Modulation System. Most radar sets employ the pulse system of deflection. In this system, the transmitter is turned on for short periods and off for long periods. When the transmitter is on, it radiates a short burst of energy called a pulse. This pulse will strike an object, part of the reflected energy is returned to the receiver, and is displayed on a cathode-ray tube. As the transmitter is turned off after every pulse, it does not interfere with the receiver. Complete location of an object in space depends on the range or distance of the target from the antenna and the direction including both the azimuth and elevation directions. The primary purpose of a radar set is its ability to measure distance in terms of time. In useful terms for radar, radio waves travel one nautical mile in 6.2 microseconds, or one radar mile (out and back) in 12.4 microseconds. If a pulse of energy was transmitted toward a target and the echo returned 620 microseconds later, the distance of the target would be 50 miles.

$$\frac{620}{12.4} = 50 \text{ miles}$$

In the pulse system, the time duration of the pulses may vary from 0.1 to 50 microseconds If the transmitter is turned off before the reflected energy returns from the target, the receiver can distinguish between the transmitted pulse and the reflected pulse. After the reflections have returned, the transmitter can

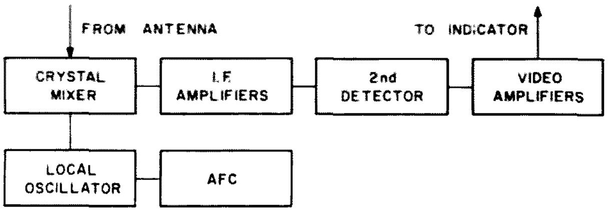


FIGURE 3
Simplified block diagram of a radar receiver

be turned on again and the process repeated. The receiver output is applied to an indicator that measures the time interval between the transmission of the energy and its return as a reflection.

Fundamental Radio Concepts

The fundamental elements of a radar system consist of the transmitter, modulator, antenna, receiver, indicator, and power supply. A functional diagram of a simple radar system is shown in Figure 1. Figure 2 shows a simplified block diagram of a transmitter and modulator and Figure 3 shows a simplified block diagram of a receiver.

The transmitter provides extremely high-power pulses of rf energy for a very short time. The frequency must be very high to allow many cycles to get into the short pulse.

The modulator produces the synchronizing signals that trigger the transmitter the required number of times each second. It triggers the indicator sweep and coordinates the other associated circuits.

The antenna is very directional and usually is a dipole used in conjunction with parabolic reflectors. Ordinarily, one antenna is used for both the transmitter and the receiver and a switching device is used to connect it to the transmitter when a pulse is radiated, and to the receiver during the interval between pulses. The antenna is a rotatable array and continually searches for targets within its range.

The receiver is usually a superheterodyne type, is very sensitive, and is capable of accepting signals within a 1 to 10 megacycle bandwidth. It presents video pulses to the indicator.

The indicator presents necessary information to locate a target on the indicator screen. The method of presentation is called "scan." There are about 15 types of scan used in radar receivers but the most common ones are: type A, B, PPI, and E.

The power supply furnishes all ac and dc voltages to the radar system.

Certain parameters are associated with all radar systems. These parameters consist of carrier frequency, pulse-repetition frequency (PRF) (the number of pulses sent out each second), pulse width (in microseconds), and power relation (relationship of peak and average power).

The carrier frequency is the frequency at which the rf energy is generated.

The range of a radar set depends upon the pulse-repetition rate provided the power is sufficient. For example, if the repetition rate is 250 pulses per second, the period of time is $\frac{10^6}{250} = 4000$ microseconds. At 12.4 microseconds per mile, the range will be $\frac{4000}{12.4} =$ approx. 322 miles.

The minimum range at which a target can be detected is determined largely by the width of the transmitted pulse. For example, a pulse width of one microsecond will have a minimum range of 164 yards. A target within this range will be blocked out on the indicator. For radar navigation work, the pulse width is normally in the order of 0.1 microsecond. For long range work, the pulse width is normally from 1 to 5 microseconds.

The transmitter's useful power contained in the radiated pulses is called peak power. The transmitter's average power is low compared with the peak power. The greater the pulse width, the higher will be the average power. The longer the pulse-repetition time, the lower will be the average power. Duty cycle is the fraction of the total time that rf energy is radiated. This is represented as

$$\text{duty cycle} = \frac{\text{pulse width}}{\text{pulse-repetition time}}$$

High peak power is desirable to produce a strong echo return and low average power is desirable to keep the equipment compact.

Summary

Throughout the years that radar has been in use, it was pioneered and developed primarily by the various military services. In addition to being used by the military, it is used by civilian organizations for:

1. Determination of vehicle speeds on highways,
2. Radar weather prediction,
3. Commercial air navigation, and
4. Safeguarding aircraft and merchant ships from collision hazards.

Radar equipments are grouped into many classes, but in general it can be said that some of the classes are air search, surface search, fire control, identification, ground and carrier-controlled aircraft approach, range rate or speed, and height finding. . . . W1MEG

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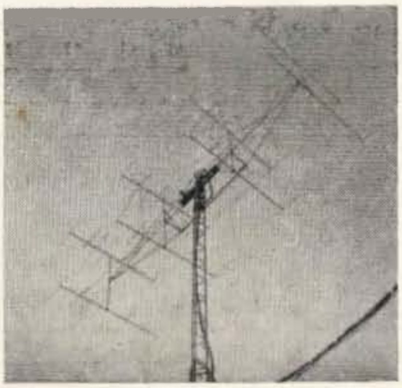
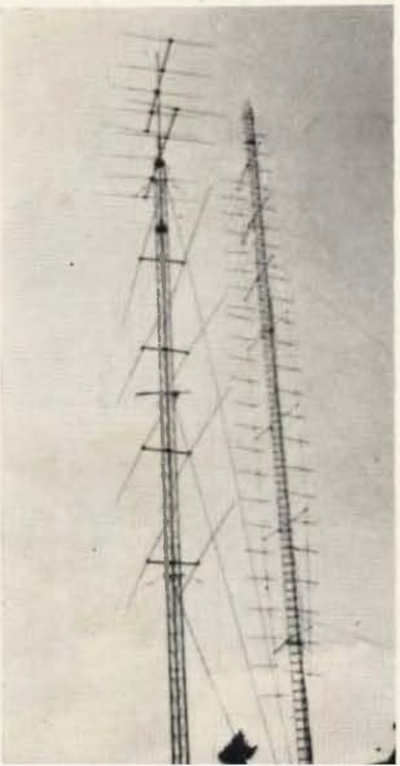
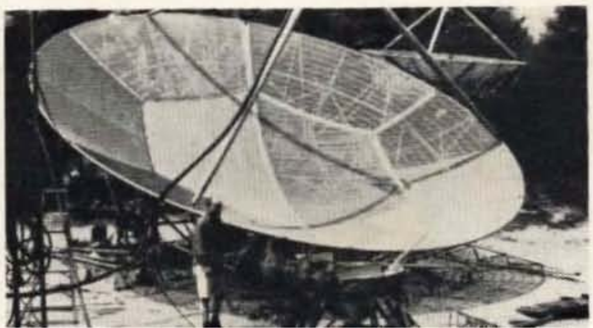
Amateur Radio

JULY 1964
Special Sale: 40c

SPECIAL VHF ISSUE





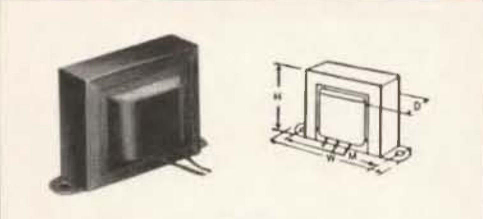


REPLACEMENT TYPE TRANSFORMERS & REACTORS

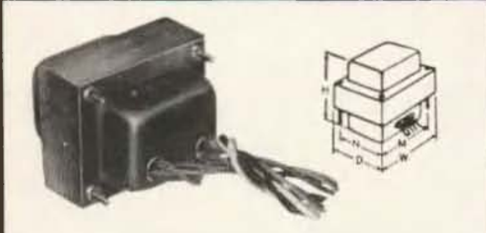
PIONEERS IN MINIATURIZATION

Thirty years of pioneering by UTC's research, design, and engineering staffs assures you quality and reliability unexcelled in the industry. UTC's line of stock and special custom built items covers virtually every transformer and filter requirement for both military and commercial use.

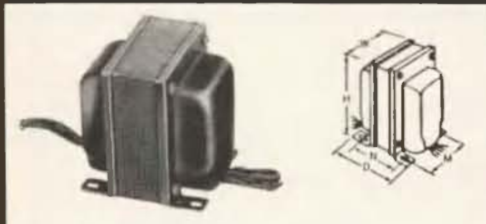
UTC replacement type transformers, here described, (Pri. 117 V. 50/60 cycles) provide the highest reliability in this field. All units are low temperature rise, vacuum sealed against humidity with special impregnating materials to prevent corrosion and electrolysis. Shells are finished in attractive high lustre black enamel.



CHANNEL TYPE



DOUBLE SHELL TYPE



VERTICAL SHELL TYPE

CHANNEL FRAME FILAMENT/TRANSISTOR TRANSFS.

Pri. 115 V 50/60 Cycles—Test Volts RMS: 1500

Type No.	Secondary	W	D	H	M	Lbs.
FT-1	2.5 VCT-3A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-2	6.3 VCT-1.2A	2 7/8	1 1/2	1 11/16	2 3/8	3/4
FT-3	2.5 VCT-6A	3 5/16	1 7/8	2	2 13/16	1
FT-4	6.3 VCT-3A	3 5/16	1 7/8	2	2 13/16	1
FT-5	2.5 VCT-10A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-6	5 VCT-3A	3 3/4	2 1/8	2 5/16	3 1/2	1 1/2
FT-7	7.5 VCT-3A	3 /4	2 1/8	2 5/16	3 1/8	1 1/2
FT-8	6.3 VCT-8A	4	2 1/2	2 3/8	3 5/16	2 1/2
FT-10	24 VCT-2A or 12V-4A	4	2 5/8	2 3/8	3 9/16	2 1/2
FT-11	24 VCT-1A or 12V-2A	3 3/4	2 1/8	2 5/16	3 1/8	1 1/2
FT-12	36 VCT-1.3A or 18V-2.6A	4	2 5/8	2 5/8	3 5/16	2 1/2

Taps on pri. of FT-13 & FT-14 to modify sec. nominal V, −6% +6%, +12%

Type No.	Secondary	W	D	H	M	Lbs.
FT-13	26 VCT-.04A	2 1/8	1 3/8	1 1/4	1 3/4	1/4
FT-14	26 VCT-.25A	2 7/8	1 5/8	1 11/16	2 3/8	3/4

DOUBLE SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-101	275-0-275	50	2A	2.7A	3	2 1/2	3	2 1/2	2	2 1/2
R-102	350-0-350	70	3A	3A	3	2 1/2	3 3/8	2 1/2	2	3 1/2
R-103	350-0-350	90	3A	3.5A	3 3/8	2 7/8	3 13/16	2 13/16	2 1/4	4 1/2
R-104	350-0-350	120	3A	5A	3 3/4	3 1/8	3 7/8	3 1/8	2 1/2	5 1/2
R-105	385-0-385	160	3A	5A	3 3/4	3 1/8	4 5/16	3 1/8	2 1/2	7

VERTICAL SHELL POWER TRANSFORMERS

Type No.	High V.	DC ma	5V. Fil.	6.3 VCT Fil.	W	D	H	M	N	Wt. Lbs.
R-110	300-0-300	50	2A	2.7A	2 5/8	2 13/32	3 1/4	2	1 3/4	2 1/2
R-111	350-0-350	70	3A	3A	2 5/8	3 7/32	3 1/4	2	2 3/8	3 1/2
R-112	350-0-350	120	3A	5A	3 5/16	3 11/16	4	2 1/2	2 5/16	5 1/2
R-113	400-0-400	200	3A	6A	3 7/8	4 5/16	4 5/8	3	3 1/8	8

CHANNEL FRAME FILTER REACTORS

Inductance Shown is at Rated DC ma—Test Volts RMS: 1500

Type No.	Induct. Hys.	Current	Resistance Ohms	Dimensions, in. W	D	H	M	Wt. Lbs.
R-55	6	40ma	300	2 3/8	1 3/8	1 3/8	2	1/2
R-14	8	40ma	250	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-15	12	30ma	450	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-16	15	30ma	630	2 7/8	1 1/2	1 11/16	2 3/8	3/4
R-17	20	40ma	850	3 5/16	1 5/8	2	2 13/16	1
R-18	8	80ma	250	3 5/16	1 5/8	2	2 13/16	1
R-19	14	100ma	450	3 3/4	1 7/8	2 5/16	3 1/8	1 1/8
R-20	5	200ma	90	4 1/8	2 1/4	2 3/8	3 5/16	2 1/2
R-21	15/3	200ma	90	4 1/8	2 1/4	2 3/8	3 5/16	2 1/2
R-220	100/8 Mhy 25/2 Mhy	2.5A 5A	.6 .16	3 3/4	2	2 5/16	3 7/8	1 1/2

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73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

July, 1964

Vol. XXI, No. 1

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de W2NSD/1

never say die

It has not escaped me that I am being attacked in letters and publications from the ARRL, by CQ, the Washington News Letter, etc. You've probably read some of these attacks, or at least heard about them over the air. Let's see what this is all about.

Basically you have to decide whether amateur radio is fast losing ground or whether everything is in safe hands with no need to worry. In support of my hypothesis that all is not only not well, but is in really bad shape I point to articles in QST and 73 discussing the ITU and our problems with our own government. We find that more and more fellows who have an understanding of the overall situation believe that the bulk of our low frequencies are in great danger of loss at the next ITU administrative conference and that our VHF's are being lost right here at home.

Obviously some alarm is being felt at ARRL HQ or else the directiors wouldn't have OK'ed $100,000 for preparations for Geneva when they believe that they are going to have a net loss of about $50,000 for the year without that expenditure.

If I am wrong and there is really nothing to worry about then obviously I am either naive enough to be mislead or am out to stir up controversy in the hopes of greedily filling my own pocket as a result. If I am wrong why did they vote that $100,000?

Now, suppose I am right and things are in bad shape. This puts me in the position of being one of the few people that are actually doing anything about the situation. What have I done? First of all I have initiated the Institute of Amateur Radio which is now in the hands of a set of interim directors and has established the foundations for a lobby in Washington which will represent amateur radio and help counter the pressures aimed at taking away our VHF bands and also try to set up the best possible atmosphere for support of amateur radio by the U. S. delegation at Geneva. The Institute is sending out a regular newsletter to every U.S. Senator, U.S. Representative, Governor and official in Washington that is involved in amateur radio.

On my own hook, and without any connection with the Institute, I have been trying to bring clear thought into the matters of incentive licensing, RM-499 and other ARRL dogmas. I intend to try to bring light into the ARRL Directors elections this fall in the hopes that this will result in the selection of some intelligent and dedicated amateurs.

What are *you* doing? What have *you done*? I've had a helping hand from a small group of fellows, but I've had a lot of QRM too. As far as I know, no one in history has ever been able to accomplish anything without others fighting him tooth and nail.

CQ has been biting at me for the last couple months. Having worked for the Cowan family for five years I feel I know them pretty well. I don't know of anything *they've* done for ham radio. I feel they are strictly commercial and that they thought that a controversial editorial or two would help sell their magazine.

I have perhaps gotten a little nastier than I should have in some of my editorials. Perhaps this was me fighting back at the personal attacks on me . . . or maybe it was carrying the battle to the combatants. Ham radio is in the fix it is in right now because a few people have inexcusably blundered. Perhaps I should be polite and not mention names and not point my finger at the blunderers.

If we all recognize the difficulty that we are in and do everything in our power to straighten things out we could keep ham radio going for a long time and have it continuously improve. I don't know how much can be done with ARRL HQ fighting every inch of the way.

Unfounded Rumor

Back in the May issue of 73 my terseness tripped me up again. If you'll allow me to slowly disengage my moccasin from my mouth, I'll explain.

Due to a lousy upbringing which instilled in me a compulsion to be right, I go to great lengths to make sure that what I write is true at the time it is written. Unfortunately the courts of our land sometimes take a dim view of rightness and have been generously awarding large sums of money in libel suits, even where the writer proves conclusively that what he wrote was true. I personally think things have come to a pretty pass when the truth of a statement is no defense, but as long as that is the law of the land you'll find my facts equivocated, complete with "unfounded rumors."

In looking over my editorials for the last three months I see no instances of rumors

which were unfounded or even any facts which have not withstood the test of time. About the only change that has come about since writing the editorials is that now, probably as a result of my needling, K2US is permitting visiting amateurs to operate. 73 still is not acceptable as an exhibitor at the ARRL National Convention. It is possible that I'm just hearing from a bunch of soreheads like myself, but I get the feeling that this ARRL National Convention may lay the biggest egg in ham history. One of the largest ham manufacturers, after some serious second thoughts, has just cancelled out of the convention. Others have turned thumbs down on it on ethical grounds. In addition to HARC's frightened rejection of 73 there is still their mysterious involvement in the Coca-Cola affair to cool interest in the convention.

I've been under pressure to sue HARC/-Dannals to have 73 admitted as an exhibitor at the convention. I probably could make it stick too, for it would not be difficult to show that their action is definitely a restraint of trade and would cause 73 considerable damages. Somehow I just don't like to resort to that. I suppose I should be practical about it and blast in, but I don't like to be that way. I guess it is the same feeling that has kept me from suing CQ for the fortune they still owe me.

Let's see, where was I? Oh, yes . . . regarding my editorials. If you think you've found any place in my editorial where I don't have my facts straight you let me know and I'll try to clear up the item for you.

B of D

The July issue of QST will have the full minutes of the ARRL Board of Directors. It'll be back there in the fine print. As you read through the unbelievable inconsequentials that filled most of few scant hours of the meeting perhaps you'll share my disappointment that the directors should go to all the trouble to get together for so little results. Dividing the time of the meeting by the number of issues taken up we see that about seven minutes each were devoted to the matters at hand. This is about enough time to read the proposals to the assembly and record the invariable (except for one item) unanimous vote.

Ham radio is more in danger of complete demise today than it has been in most of our lifetimes. We're losing the VHF's here at home and the short waves at Geneva. At this crucial time in history we desperately need a

(Turn to page 88)

IoAR News

Founding Members of the Institute of Amateur Radio

KØGZN	K2ATG	W6FUV	W5GHY	W7ABD	F2BO	K4AQV
W1ELL	W5TIE	WØNVE	W5AKZ/4	W5CDM	K2JXL	K9KHE
W1PCD	K2GCL	K5WYN	W6QWE	KØPZT	WA8EJX	WA2VMV
W1AFW	K2ZSA	WA9PHH	W9IIU	K8GGW	WA5CXG	K4QYC
W1BEY	WB2ASY	WA8GRI	XE2WH	WN2JBB	WA5ERV	K9ATG/4
KØEBV	KN3YPV	K3FKN	K8NZD	W6FPO	K2QKS	K5OMD
W8DBK	W2COT	WA4AYP	K9UTN	WA9GAA	K8ENY	WØOPA
W6BRW/1	W7UVR	K7QKN	DL4UC	K6GLJ	KØFYM	W4RLS
VE3CAH	K9ZTE	W9RLH	W8BPY	WA6UNL	WØJHY	W6FAV
WØKZZ	WA2FMC	WAØCSE	WA2PGY	W1EGE	W7GBJ	W7PXA
KH6ARL	KØKPG	W4EVU	W3CAY	K8UFJ	WA6QVS	K8KSC
WA1AWG	K5AJP	WN8BYM	WA4PDX	WA6VAT	WA4GMV	W1HIV
W5WNF/1	W6QDO	W5AEW	W7VBH	K1RFX/7	K4LOL	W6RDB
K1LKK	W9AFG	W3BIG	K5ZZP	K5RKG	W5HDY/Ø	W2LMP
W1OFK	W8BKO	WB2DML	W5QKA	W8GRT	WA5EKQ	W2GQY/4
K1AFH	W2NSD/1	K5OZN	K2SEP	W6CRA	K4BNZ	WB6GOB
W2MAB	K6UVL	WA6YOV	K1QAC	WA6JNI	WØGBG	KØMUJ
K9HMC	W9CDQ	K9FLX	WA4ABR	W7DIE	K6IZY	KH6BW
KØJXN	WA2UHV	K2VBH	K6AYO	W6EXI	WA6NCD	KH6DDZ
K8UBG	K9TZJ	K5ZXL	K1FJT	WA6KRJ	WA6TAG	K8DMG
WB2LZQ	WAØAVG	W1TXS	WA2QDJ	WØCZA	K3URS	WØEXG
W8PJJ	K7YNY	W9UIK	WA2PWG	K8JTT	K7UCR	KØATZ
KØPWS	W4WNI	K9VEO	KØUIW	W3KIZ	WA4FTM	W2PDH
WA9COE	W2KEG	K3BNS	W2QR	WØRQY	WB6BIG	WA4HWH
W8JXU	WA6EWV	K6VYJ	W5LVQ	W7IUF	WAØDEM	K5ERF
W3AEH	K5VKO	WA8DOT	K8YRE	W2LO	K6GII	WA4LYG
K3QEY	WØYVR	W2HS	WA8HPE	K9ESN	WA6NAT	WA6KII
K3PKL	WB2FYB	W7IDF	WA4HLJ	DL4HU	Edward/W1	W4UQK
K4UOT	WA8FTX	WA4FEI	K7JAR	K7JQZ	WA9DRI	WA4RME
WØDSO	W2OBM	K5KLN	K1VOL	K9APJ	KØOKB	K9OFG
WA2DRK	KØJTQ	WA6JJK	K7NYH	WA4ILX	K9VWX	K9AHX
K9GNK	WØFVP	W6DKZ	W2YGA	K1VII	K8LBU	WAØEYE
W2DLP	K6UGT	W2DUD	KN3FML	K9PCQ	W7AER	WA6VGR
W4GIO	W7YKR	WA8ASU	WN1AJG	K5HVS	K4UBZ	W8CWF
K9WHE	KØKUP	W2ISD	K8ODY	W6LSW	K4JFZ	W9DIA
WA2NDC	WA2YNO	Igor/W2	W9FNQ	KØWZX	K2SWE	KØVFV
KØWVF	W6FGJ	WA4ABZ	K5TJW	WA6RWU	K5JPK	WA6TVR
W9DKY	WAØBUH	W3KFB	W5TEL	K6ELR	W6DAD	K4ZJK
K9SQH	W5ITU	WA2LIY	W4FMF	K9LMG	WA9AXU	WA6ZMT
KØKRX	W7GZA	WA6OIV	K9HUK	W5NSD	WØLYX	K7VUR
K8TGP	W2MSN	KZ5LC	WA5EZW	K5ARO	K6LRX	W6AVR
K8APU	W5THI	WA2UCP	WØHMK	K2VRV	WB6AYJ	WA8ITN
W2CQY/4	W1IAZ	K3GLL	K1KHH	W3PBR	W1ZMM	KH6EDR/6
W9JWW	K5RBA	K9KBQ	K5ESF	KØBIY	W2CNQ	WA6SSK
K9QPX	KØGUQ	W7DIC	W5YNL	W9MYN	W6FUW	W3PQZ
W8SDZ	K7TCY	WA2YIA	W3OGP	K6TWX	WA2SPB	W5CND
K8AMF	WA2PHF	W8RZZ	VP5BB	K4GWV	K3MTW	K1JWU
K9UON	K6SLR	K2EAF	W6BXY	W7OE	K1QNQ	W5DYR
W9KLR/8	WA4DQS	KØMVM	WA8FOE	W6UKD	W2GHK	WA6SDW
K8EIO	K1SCC	WB2DXT	K1QHT	W6AVN	K6OPG	W2SHZ
K3DYH	K5RLP	K8OHP	K1CJD	K6IFO	K2JXB	W1GJL
WA2ZID	WA2GHP	K6MIM	WA4CMW	K6GRD	K8RSC	W6SLK
WA2WLZ	WB2GVO	KØPTL	WAØELO	K5BFQ	KØCBN	K6UZB
WØRGT	W9YMF	W4COY	WB6EXR	W9SIR/4	WA6ABZ	K9JQS
K5SKA	WØKYQ	WØWUZ	WA4NGZ	K6GNG	W3HIQ	WB2ISM
W5AQN	K7KYG	W5HWL	W3WTO	K1UDF	W4QLX	K3ZNM
K5IXH	WA4FSK	WA2STD	W4NGZ	W6JWF	WA2KXH	W7SOD

An Open Letter to Every Technician Licensee

You may feel that all the recent controversy, political name-calling, petitioning for HF license changes, and loss of large chunks of (or *all* of) 40, 75, and 20 meters has nothing to do with you. You LOST 1645 mc's a couple of years ago in a *closed door* committee decision that QST buried in its back pages in such fine type that I can't even find it to give the exact date. Let me quote: "*The Bands 220 through 10,500 mc are shared with the government radio positioning service, which has priority.*" You can get a phone call—the voice on the other end can tell you to get off any of these frequencies—AND YOU WILL GET OFF!

Carefully smoked-screened and carefully dealt off the bottom of the deck a card at a time, over a ten year period, is a series of legal little-publicized committee decisions that are resulting in a complete re-allocation of all frequencies from 25 to 890 mc. *You are going to lose 6, 2, 220, and 432.*

"Electronics," a highly respected industry-wide publication, stated on page 29 of its April 20th issue, "The Electronic Industries Association's monumental analysis of Federal Communications Commission license data for most of the radio transmitters used in vehicles will be completed before the first of May. It was started nearly eight months ago and covers some 1.9 million authorized stations, etc." "For example, some 200,000 mobile station authorizations cannot be immediately identified geographically, etc." "Another group, the National Association of Manufacturers, feels that unused channel assignments should not lie idle. Its communications committee has proposed a pilot test employing television channels 14 and 15, etc." "The proposal is comparable with those of the EIA, American Automobile Association, and Automobile Club of Southern California." "The Commission recently withheld action on the NAM proposal and slapped down another that would have re-allocated frequencies between 25 and 890 mc's. However, FCC requested another study by EIA and the Joint Technical Advisory Committee, representatives from industry and members of the IEEE, to see if mobile radio channels can be fitted into TV channels 2 thru 13." Unquote.

OM: Just where do these actions leave the amateur? Who is representing our interests in these associations and committees we have never heard of? Yet they are making daily decisions that effect our most valuable frequency bands.

We have heard a lot of yak-yak about how tough it is going to be to talk some thatched-roof politico from New Lower Slobovia into letting us keep our 4, 7, and 14 mc bands. How do you think we are going to make out against the professional lobbies representing EIA, NAM, IEEE, AAA, etc. These are multimillion dollar organizations representing over *one million, nine hundred thousand* business radio installations. These groups are experts in our government processes and have years of hard-earned experience in wheeling, dealing, and outright arm-twisting. These people don't go to Washington cocktail parties—*they give them.*

The ruling that requires every TV set now manufactured to have a built-in UHF tuner of sorts is just one small step in a long series of moves that will give business radio all of the low TV channels.

Because they ignored 15 years of amateur experience on 5 and 2½ meters, the FCC botched up the original TV channel allocations so thoroughly, with no help from the networks, that it now requires a complete reshuffle of allocations. And business radio interests are making hay while the sun shines. Through a very well organized series of moves over a ten year period, these people are completely re-locating the entire radio spectrum over 25 mc.

I have never been so horribly aware that we are amateurs in a lot of ways other than radio.

I hear many dc band hams worrying as to whether the trade-in value of the thousand dollars or so in appliances cluttering up their operating positions may be affected. I have over 25 years of my life invested in what we can do on 6, 2, 220, and 432, if we can just manage to save some of these bands.

The gang of electronic undertakers representing business radio buy and sell entire corporations just to get control of a 5 kc communications channel. Don't think they haven't divvied up and dealt out our VHF amateur bands into the reallocation pot long ago.

We quit using modulated oscillators on 2½ meters in 1939, but QST still features one about every three months in their effort to

(Turn to page 66)

The Outboard RF Stage

An inexpensive and easy-to-make trough-line 432 megacycle rf amplifier using the well-known and low-cost 6AM4.

Bill Hoisington K1CLL
83 Bellevue Ave.
Melrose, Mass.

The rf stage shown here has a gain of about 20 db at 432 megacycles and will thus relieve the crystal (which is described in the next section) and the first *if* of setting the noise figure. This is good too, because with only a crystal ahead, you need something like a cascode or neutralized low-noise triode to conserve the noise figure of the crystal. There are other reasons too. Cost of a low-noise crystal; almost complete elimination of harmonic detection. Stop a minute. This last one is a real nasty. I live only a few miles from an FM station and a Tee Vee source. Not long ago I was tuning up a transistor rf stage on a weak signal generator and noticed the diode detector microameter moving around on its own. Putting my reliable little high-gain outboard transistor af amplifier in the output revealed blasts of distorted FM audio from the diode. Checking up on this assorted junk on the air I find a real offender near here is the 175 megacycle TV tower whose blinking red lights I can see at night from the window.

Harmonic detection is a name usually given to the production of *if* in a superheterodyne by the harmonics of the *oscillator* beating with strong local signals. (Just wait till all those 82 channels get going!) (So what? Just move to 1296!)

The difference in some complete rigs between reception "out in the country" and

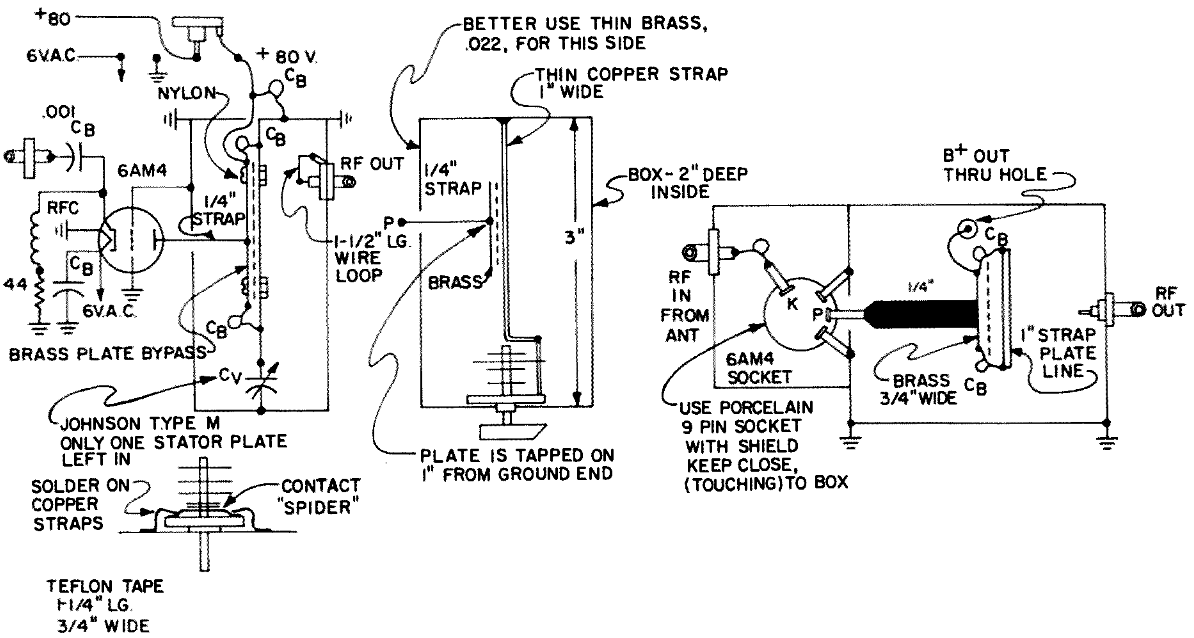


Fig. 1—Pictorial schematic of the 432 mc amplifier. Fig. 2—Trough-line dimensions for the 432 mc amplifier. Fig. 3—Front view detail of tube socket placement for the 432 mc amplifier.

"in town" is sometimes startling. Again, lots of nice hilltop locations serve to put "birdies" and horrible spurious signals all over the dial because you are now line-of-sight from a collection of FM and TV towers.

The rf stage shown removes a great deal of this junk. It also peaks up sharply on the *desire*d stations, such as on 432 (like on Wednesday at 8 P.M.)

The Circuit

Nothing too *new* here, except the trough-line box. I've seen lots of articles where it says "the box is made of brass stock, to the following dimensions, etc., etc." Well, I think machine shops are F.B. In fact I've spent plenty of time in them trying to get hard-headed foremen to build nice round cavities and things. I've also tried to build boxes of brass. Somehow, this seems to be someone else's job! I can make new devices. I can tune up a transistor on 2000 megacycles, I can devise an Infinite Shift Mechanical Transmission, but I *can't* make a decent square-cornered box! So you will find mine made of (of *course*!) copper-clad Bakelite. A ruler, tinsnips, and a soldering iron is all. And it works. High Q, shielding, *good tuning*, and all. Fig. 1 shows the basic schematic. I spent lots of time on the input cathode circuit. There appears to be very little to gain from tuning it. The filament chokes tried did not do anything for it either. Some folks carefully put chokes in *both* filament legs, some put a choke in one side and then *ground* the other with a bypass, and some do not use any. I'm in the last group, at least on this one. When the manufacturer isolates the cathode from the filament (inside the tube) so that it will *not* conduct under the stress of considerable red-hot temperature, he goes into plenty of detail and, generally, good ceramic insulation.

Circuit-wise, there is plenty of choice also. Diagrams are shown of all kinds of inputs, from direct to the cathode, to matched, resonant jobs, and even a capacitive match to the cathode on top of that. I spent more time on the input just for this reason than on the rest of the circuit, and I just do *not* find any great advantage. The straight-through rf choke shown in the cathode with the large value coupling capacitor to the antenna cable input, is not an *exact* match but near enough to show some 20 db gain. Between the last sentence and this one I plugged it in; checked it again. Just for fun, I varied the cathode resistor versus B plus, and find that a low value resistor (of 22 to 44 ohms), and a low B plus (of about 80 volts on the plate), is F.B.

Believe me, this little unit will be *very useful* around a 432 megacycle station. A *very low noise* first rf stage needs a *good* second stage after it. This is the *good* second stage.

The rest of the circuit goes along more or less standard. All grids grounded, both filaments bypassed, til we get to the plate. Here is where the trough-line begins.

Fig. 1 shows the schematic. But remember, *configuration* (i.e., shape, length, width, etc.) plays an ever increasing part from "6 UP." At 432 megacycles it is already of great importance. Mount the socket so close to the box that the shield *jams on*. Make that plate lead as short as you know how. If you tap on the plate lead *too* near Cv, you won't tune *up* to 432. You could, just maybe, make the box ¼ or ⅜ inch shorter inside, for a little greater tuning range.

Make up a brass plate with socket hole, as per Figure 3, to mount the socket and get good ground connections. There are a total of *six* of these, including one side of the filament, and five grid leads.

Put all the copper sides of the box *inside*, naturally. That's where the rf is.

RFC is about 20 turns, enamel No. 24, about ⅜" long. All the Cb's are 500 or 1000 mmfd 75 volt jobs, about ⅛ inch square. Except those on the plate bypass. These should be 250 volts. They are about 1/16 inch bigger. The B plus lead lays flat on the center one inch strap and out a hole in the rear. Being close to the plate line and running out *through* the ground end, it is *part* of the ¼ ground circuit, and will be found to be at rf ground potential at that point. For good measure, another Cb is added there. (Also 250 volts).

The output loop is about the right size to link over to the crystal mixer. A simple plate current metering phono jack is shown which current metering phono jack is shown which suits most of my meters. A ten cent shorting plug allows use of the meter on the next job.

So that's about all. It works FB and has about 20 db gain, as mentioned.

. . . K1CLL

The 432'er

Bill Hoisington K1CLL

RF Amplifier

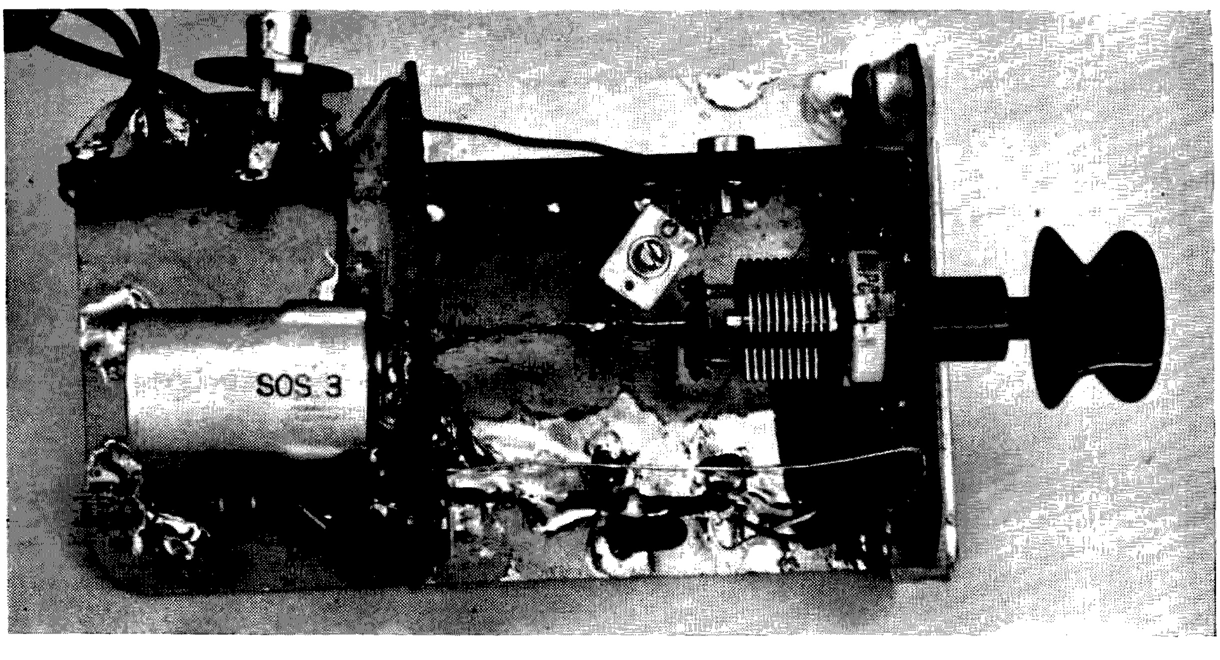
Series tuned quarter wave trough-line

A second low-cost easy-to-make 432 megacycle rf stage is described. Featured in this one is the use of a 50 mmfd variable capacitor for tuning on 432 megacycles. It functions somewhat like the big capacitor in a pi network.

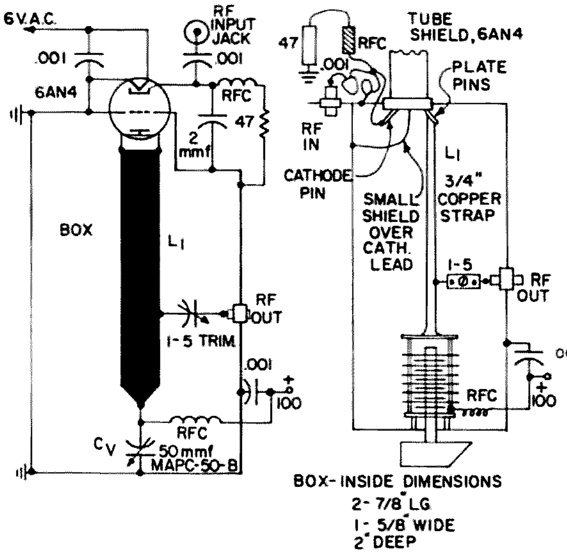
Delving further into the mysteries of rf amplifiers for 432 megacycles, we were pondering on series tuning for a ¼ wave line. Using a 6AN4 and a small 50 mmfd variable might be a neat simple way to do it. Of course, your present writer's liking for clean sharp resonant tuning presents difficulties on 432 megacycles, especially when a "build-in-a-day" unit is proposed. In one sense it is a lot easier to take a disc-seal tube (nowadays called a planar triode) like the 7077, and put it into the end of a plunger-tuned cylindrical cavity and make it work OK. This is definitely more expensive and time consuming though. So let's go with the 6AN4 and trough-line.

The schematic is shown in Fig. 1. Note that this is essentially a ¼ wave line. I say essentially because it is actually a little longer, being series tuned. The theory behind this deal is quite easy, really. If Cv was 1000 mmfd at 400 megacycles, the line would be a true ¼ wave line. (anyway, 99.99%) However, as you go lower in capacity the line begins to tune, that is, increase frequency a little. In the 50 mmfd region as shown, the 432 megacycle tuning is quite nice and spread out.

Note the choke coil attached to the cold end of the line. That is, it is almost cold, but gets hotter with rf as you tune towards 500 megacycles. This unit is also FB for 440 ATV work. (Amateur Tee Vee, Junior) Note that this circuit has also nicely avoided the always troublesome feature of plate line bypassing, while at the same time retaining the high-pass filtering action of the ¼ wave line.



The 432'er



Schematic and top view of 432 mc rf amplifier.

The 6AN4 has only 7 pins which makes it easier to work with than the 9 pin 6AM4. It can use more voltage than the 6AM4, but about 100 volts is plenty. It is also supposed to be a more "modern" tube type. I might mention here again: rumors of Nuvistor difficulties such as short life, increasing noise figure, and Military spec delays. I repeat these are only rumors, as far as I know. Maybe somebody can let us know for sure about this? I sure would like to know as I have some Nuvistor units in the works myself.

Fig. 2 shows some top view dimensions. The two grid pins are bent back and soldered to the socket, which is one of the *thin* UHF jobs. I had to take the thick porcelain socket out of a shield holder and put the thin one in its place in order to get a shield over the tube. Perhaps these sockets are now available with shields. How about that, Socket People?

The rf chokes are some 20 turns no. 22 enamel wire, on 3/16" forms, held with coil dope.

The photo shows how relatively simple this amplifier is to make up. With 100 volts on the plate the mils should be about 6—well under ratings. The gain is 20 db or over, which should do FB to set the noise figure of the mixer and first *if* following.

Most of the other items brought up in the article on the 6AM4 apply here also, such as usefulness in the 432'er, etc.

Note that this is not a completely shielded planar job, and there is a slight amount of regeneration when LI is unloaded. Remember, this is quite high-Q circuit, with the output cable disconnected. With 50 ohm cable matched in and going to the mixer it is quite stable, however, with no need of neutralization.

Tuned Trough-Line Mixer

Bill Hoisington K1CLL

Continuing the receiver section of the "432'er," the tube mixer naturally comes next. 6AM4's, 6AN4's, and my favorite 1200 megacycle tube—the 6AF4 or 6AF4A—were tried. The 6AF4 won out here, with noise about equal but more gain and better tuning. The large number of grid leads and the larger grid structure itself (of the two grounded grid type tubes, the 6AM4 and the 6AN4) probably account for this.

Table one shows comparative results of the crystal mixer, the tube mixer, the crystal mixer with rf, the tube mixer with rf, and—just for fun—the tube mixer with two rf stages.

Further tests on the air with the completed front end of the 432'er are described in the next section. The tube mixer with the rf stage works very FB. Resonating the rf stage shows plenty of "life," bringing up the noise about 1½ S units, and the signals even more.

The two trough-lines (see previous section on rf stages) can be built together with a common wall if desired. Of course, as a "permanent experimenter" my receivers are almost always in sections.

Construction follows along the lines of the rf stages already built, and uses a ¼ wave trough line, series tuned with a 50 mmfd

TABLE I

Front End	Morrow "S" Meter
Crystal mixer	8.4
6AF4 mixer	9 + 2.5 D.B.
Crystal mixer plus R.F.	9 + 10 D.B.
6AF4 mixer plus R.F.	9 + 14 D.B.
Ditto, plus 2nd RF stage	9 + 26 D.B.

capacitor which handles well on 432 megacycles; using it somewhat as the large capacitor of a PI network. See Fig. 1. This capacitor also serves as the grid capacitor with the grid resistor tied to the cold end of the line.

Both inductive (loops) and capacitive input circuits were tried. Not too much difference, so capacitors were used. They are also more readily adjustable, for loading and matching.

The 432 megacycle rf is bypassed out of the two plate leads of the 6AF4 with a small 5 mmfd to ground on each plate. See Fig. 2. The tuning of the 28 mc output plate coil, of course, includes that 10 mmfd.

Adjust the link, L3, for your receiver and the cable. I use RG-58/u everywhere, but suit yourself on that. With links, the cable may be of any length. On 28 megacycles, three turns of tight coupled link is too much coupling. Two turns for L3 at the cold end of L2 is about right, but check with a little looser coupling if L2 does not peak up properly.

The plate voltage of the 6AF4 was given special attention, which was justified by the results. Do not use more than 25 volts, with some 1 to 2 mils current. This is by far the most sensitive operating point found here under test with DX signals.

The local oscillator chain, which follows this article, using two 12AT7's in a doubler chain, ending up on 404 megacycle in a high-

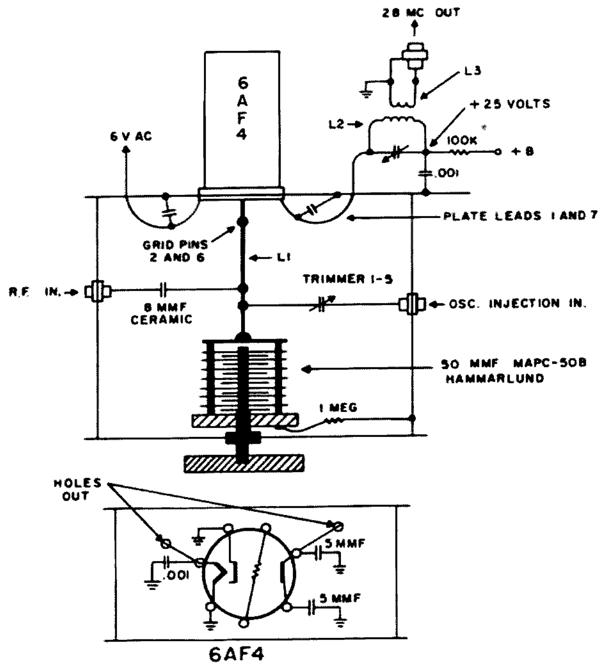
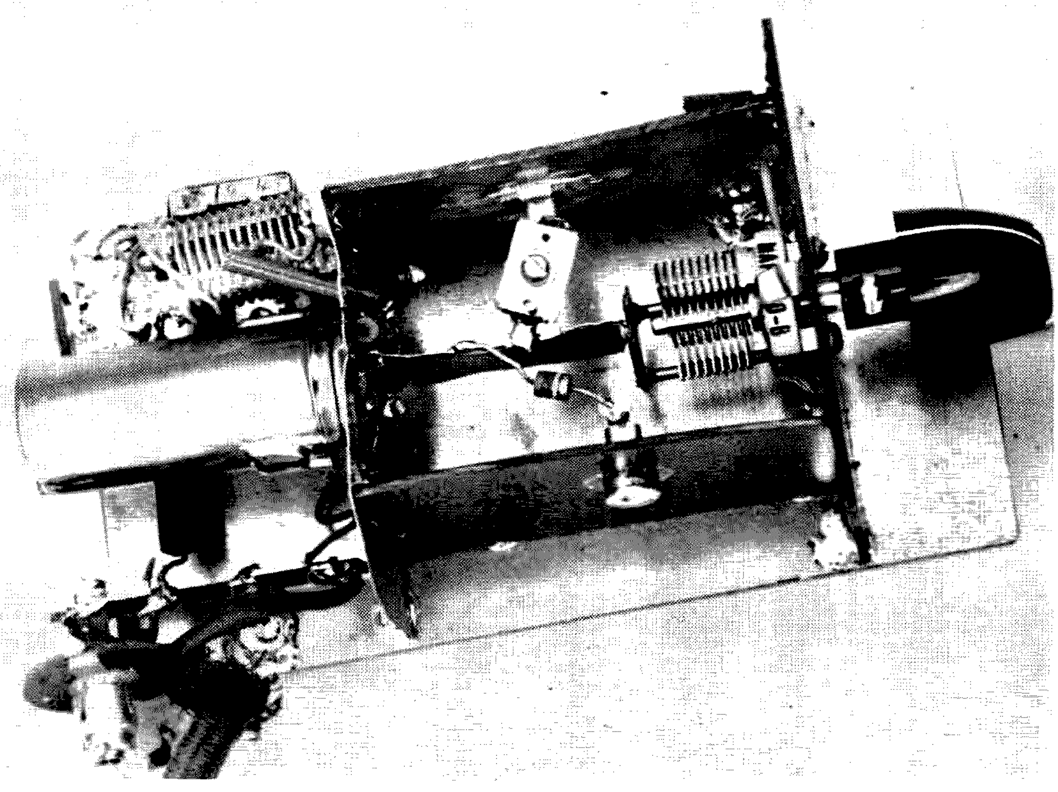
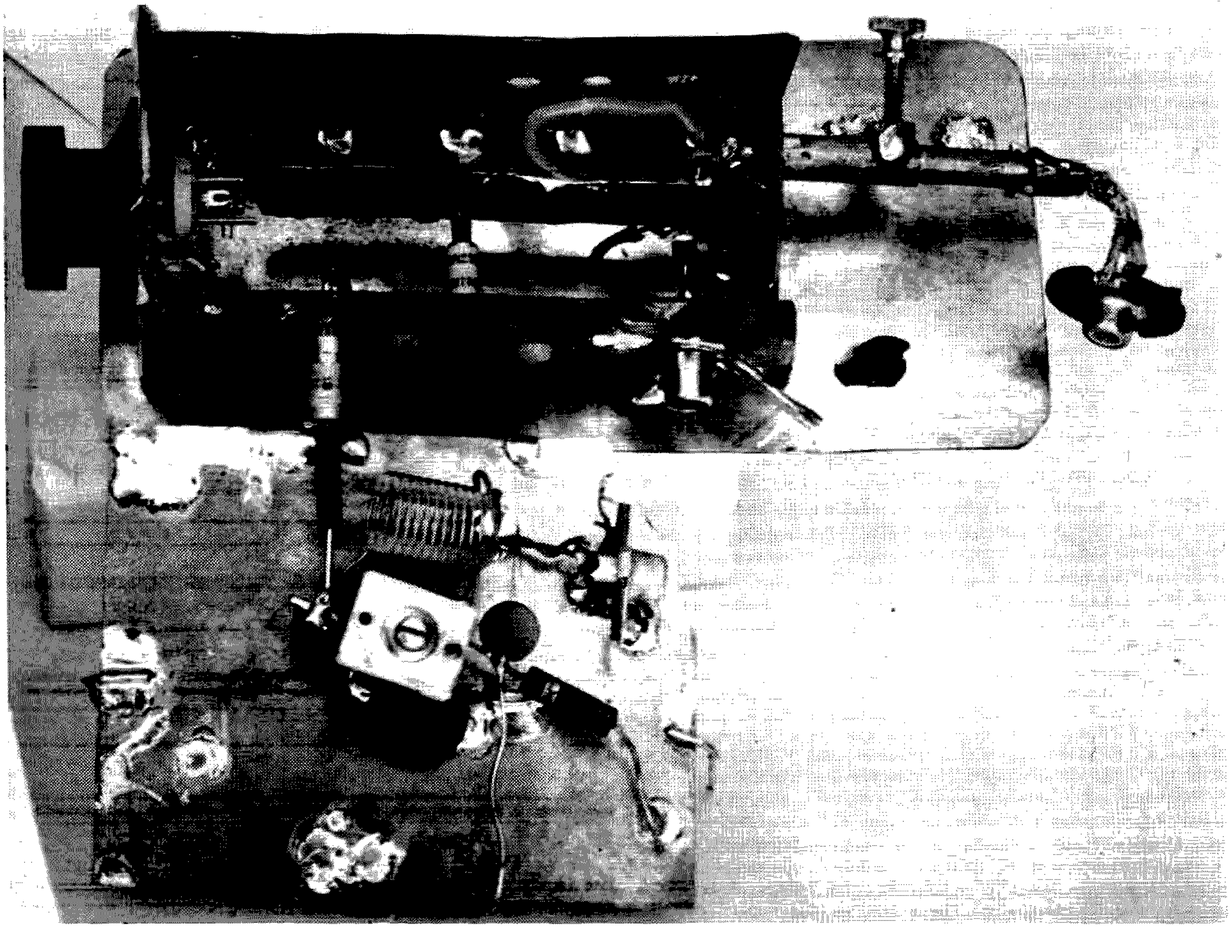


Fig. 1—Top view 6AF4 Mixer—432 mc. Note: Grid strap L1 is 1 ½" long by ¾" wide. Trough-line is 2⅝" long by 1⅝" wide. I.D. Walls are 2" high. L2 is tuned to 28 mc, 12 turns airwound, 16 per inch. L3 is 2 turns around cold end

Fig. 2—Inside rear wall detail of 6AF4 Mixer, 432 mc. Note: The bypasses shown must be small and use short short leads. Both grid pins, 2 and 6, are soldered to L1.





pass small parallel-tuned strap line that almost completely eliminates the 202 megacycle energy. About 150 volts is used on the 12AT7 L.O. chain. This also suits the rf stage but is not critical.

Again I would like to mention the question of tube versus transistors for amateur use. There appears to be considerable trend towards transistor UHF circuits in the Tee Vee world. But even here one large manufacturer puts out a UHF front end in two models; one with a tube oscillator and one with a transistor oscillator—both using the same preselector and crystal mixer. So you see, it's your choice—at least for the present. Personally I'm not sure myself which I will prefer eventually.

Incidently it is very interesting to note that some of the Tee Vee front ends "steal" the plus 12 volts for the transistor oscillator from the regular 150 volts supply in the set! This, of course, is possible because of the NPN silicon transistor used. Just remember when transistors have an "N" at the beginning and end, like NPN, they may be considered to conduct with electrons which need a positive voltage to attract them, like the plate circuit of vacuum tubes.

So, that winds up the tube mixer stage.

. . . K1CLL

CORRECTIONS

Dear Wayne,

Please refer to May 64 "Inboard Calibrator for the NCX3 article." What is the value of the unidentified resistor?

Tnx, H. Stephens, WA6UWT

The unidentified resistor is R3 and its value is 22K.

Dear Wayne,

In response to my article in May 64: No power Supply tube type is given, but if terminals 2&7; 3&4; and 5&6 of the tube socket are connected together, the lucky novice may use a 5AU4, 5AW4, 5R4 5U4, 5AS4, 5V3, 5V4, 5X4, 5Y3, or 5Y4 depending upon which is subject to scrounging.

Robert Sressel K1WXY

Dear Wayne,

W1MEG's article on the TS-118A/AP watt meter had an error. You cannot use this as a dummy load on frequencies below 20 mc by disconnecting the meter M201 at jack J202 for there is a 5 uh choke bypassed with a 500 mmfd capacitor from the 50 ohm line to J202. This choke and bypass must be removed to use it below 20 mc or zap. This can easily be done by removing J202 and unscrewing the choke through the hole.

Nick Skeer K1PSR

The 432'er

Local Oscillator Chain

Bill Hoisington K1CLL

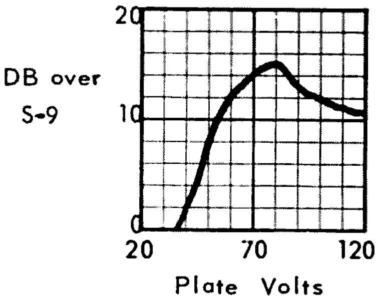
There is "solid" controversy on the question of "Tubes Versus Solid State." With higher power for 432 and 1296 definitely here, and climbing, the danger of transistor deterioration when used near transmitters is still with us. Granted, protection means are available, but at increased cost and complexity. Some *tubes* need protection too! It appears that Nuvistors *may* be among these! The subject of receiver *vulnerability* and protection is a study in itself, to be gone into later.

L. O. Chain

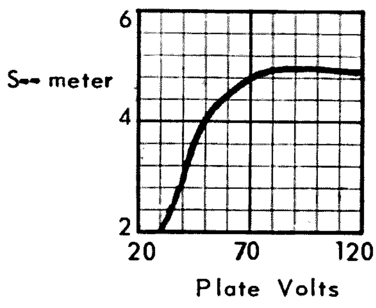
Success with strap-line circuits to 1300 megacycles using transistors and 6AF4 tubes recently (just look in 73) gave us some new ideas on how to build low-cost, easy-to-make versions for 432 chains with the "lowly" "ever-present" 12AT7's. Plenty of circuits to 400 megacycles have been shown using the same, but the ½ wave line can be subject to considerable 200 megacycle feed-thru into the final tank. The use of sheetmetal B plus bypass capacitors, combined with ¼ wave strap line and 50 megacycle crystals, works out quite well. We were able to build the following crystal controlled local oscillator chain for the 432'er in less than a day.

Again, with a preference for fool-proof, *good* operation, the four circuits operating as shown in Fig. 1 put out 500 microamperes of good clean rf on 404 megacycles with *only* a 25 volt plate supply! (See curves below for best operating voltage.) I do not like oscillators or circuits that are running maximum or over dissipation in order to keep going. For example, the 6AF4 is a FB tube, and still works well in the 1100 to 1300 megacycles region as a tuned oscillator. But over 1300 the dissipation is climbing rapidly and the plate mils for oscillation go up. It still lights a bulb with rf at 1296 megacycles, but at about 1500 megacycles it is all through. So the low-voltage test is always a favorite of mine. Funny thing about Super-Hets. Somewhere in it there is always an oscillator or two, and these had better be *good* ones. Again, the emphasis is on easy-running ones, *without* much *voltage* in them. So the above chain, which will loaf along FB with only 50 volts B plus, qualifies.

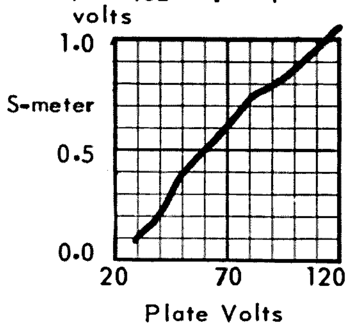
CURVE 1 'S' Meter Vs overall plate volts



CURVE 2 'S' Meter vs plate volts, low level RF



CURVE 3 RF output 432 mc, vs plate volts



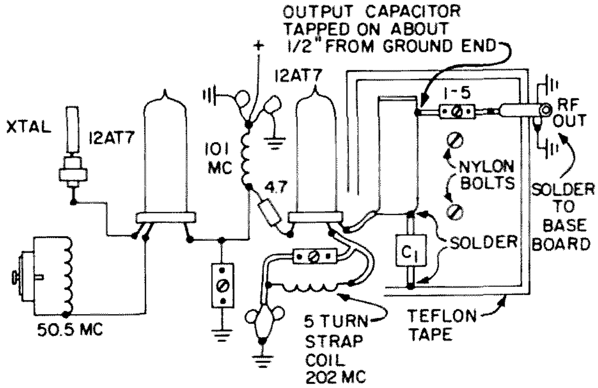


FIG. 2 GENERAL LAYOUT, TOP VIEW, 404 MC LOCAL OSCILLATOR CHAIN

Actually, more can be used—anywhere up to 250 volts, at which point a 120 milliwatt bulb can be lit on the plate circuit. Careful checks have been run on the amount of oscillator injection needed, with both tubes and crystal, and these tests are greatly facilitated by an efficient L.O. chain with variable B plus. These tests are already done by yours truly, and it is *not* necessary to repeat them unless you *want to.* (See below)

The oscillator circuit, (see Fig. 1) using ½ of the first 12AT7 and a 50.5 megacycle crystal uses a *regenerative* grid circuit. The *degenerative* coupled crystal phase reversing circuit, used with transistors and pentodes, works with the 12AT7's, but more output is obtained with the *regenerative* coupling. I have checked about a dozen crystals around this frequency and they all work the same. The doubler stages—50.5 to 101 and 101 to 202 megacycles—use well known simple circuits. Just use the capacitors and coils shown and check carefully for *desired* frequency versus *undesired* frequency, with absorption wavemeters and tuned power detector units, and you can't miss. Just for fun we tried copper strap for the 202 megacycle plate coil, and it has 5 turns, or one *more* turn than the 101 megacycle coil! Part of that is the smaller diameter, but also it shows the low inductance value of strap coils!

The 202 to 404 megacycle stage needs a little more care. Notice that at 202 megacycles the plate coil already uses strap and has only 5 small turns. Putting down a good plate inductance return, or B plus bypass, in combination with a ½ inch copper strap will do the job. The "Hammerlund type MAC helps

too! The point to observe here is that the rf wave (not the electron path!) flows down the plate inductance and must get back to the starting point, which in this case was the cathode. Watch out for that. In grounded-grid, "grid-wall," or "grid-separation circuits" different action occurs.

In our little 404 megacycle circuit here, the rf flows nicely from the plate down the strap and back to the cathode on the flat sheet

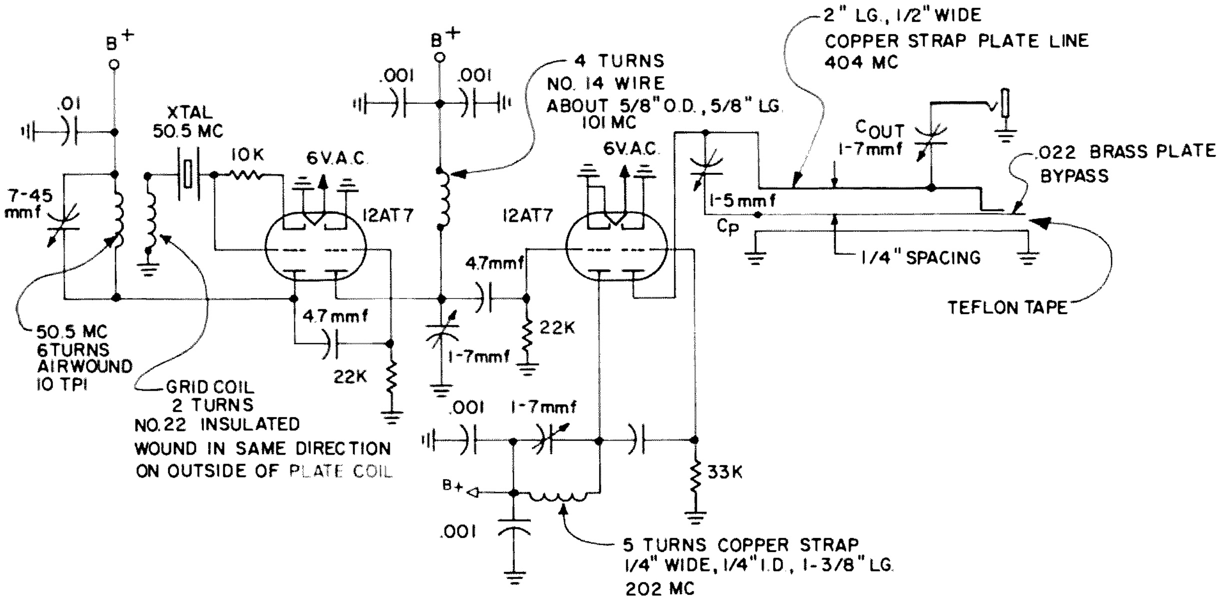
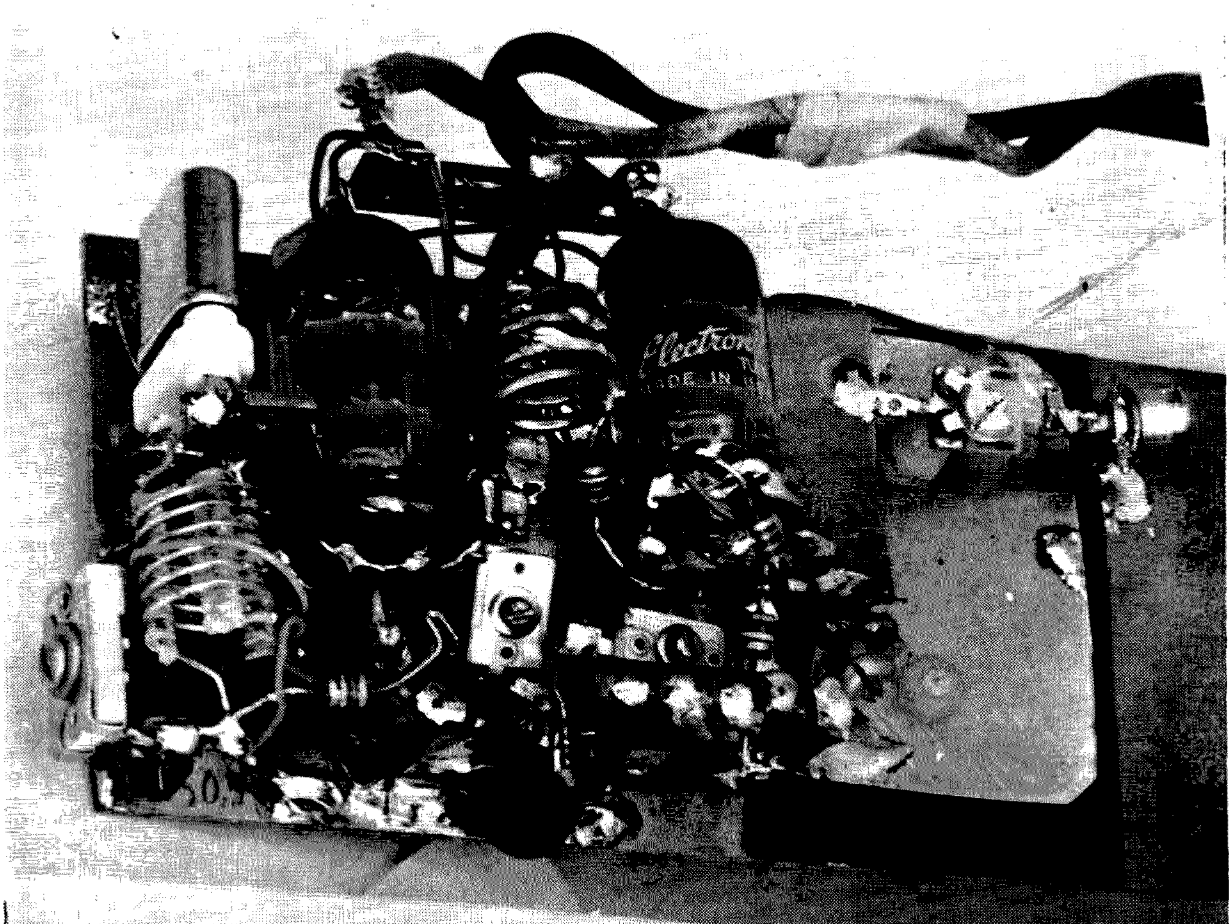


FIG. 1 12AT7 LOCAL OSCILLATOR CHAIN, 404 MEGACYCLES



brass capacitor which also forms part of the plate inductance.

Note carefully that if you leave this line "float," as a half-wave line (longer, of course) with a small capacity on the far end, it is a perfectly legitimate 404 megacycle circuit—but you can get a *lot* of 202 through it. If you use it as a ¼ wave circuit, bringing the sheet bypass back to the cathode, (rf-wise, that is) you have a high-pass circuit which cuts off at 400 megacycles, and little 202 shows in the output.

Well, that's pretty near all the fine points. The output cable matching capacitor works well. You will find an intriguing point here. No matter how you tune the plate line, a much greater output will be found with C-out at the proper point. Of course, both capacitors work together, near this point, but the influence of C-out is very apparent.

The old reliable No. 49 Mazada pilot light, 2 Volts - 60 M.A. (120 milliwatts if my arithmatic holds) will light from the 404 megacycle rf when about 250 volts of B plus is applied to the chain. This is still under the dissipation of the 12AT7's but no such amount of milliwatts are needed for L.O. service.

The proper amounts of oscillator rf for the crystal mixer are shown in the attached curves.

Careful checking for crystal oscillator stability versus sensitivity (see the attached curves) shows that little or no regeneration is needed. Looking at both the chains finished, I find no more than two turns are needed.

Pursuing the ultimate goal of making up a good, low-cost, 432 megacycle complete station, we checked operation of the tube L.O. chains with the crystal mixer previously described. The results are shown in curves 1 and 2. Curve 1 shows B plus voltage (for the whole chain) versus S meter readings. This is on my Morrow Receiver, (a 13 tube job with 6 tuned stages at 200 kc, fairly representative of a "Receiver-type I.F." at 28 megacycles,) using an "S9" signal from the underfed mixer at 30 volts, to the best region of around 80 volts, and then a slight drop-off at plus 120.

For a check on a weaker signal, curve 2 was run. Note that this also peaks on 80 volts but is flatter up to 120 volts.

Curve 3 shows the rf volts out of the L.O. chain corresponding to the B plus used.

These rf volts were measured as dc voltage output of the tuned 432 megacycle power detector previously described.

Bill Hoisington K1CLL

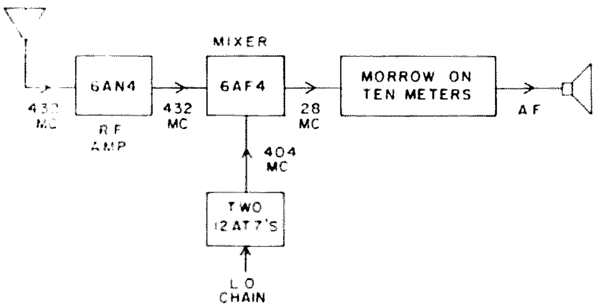
First Evening of Listening on 432

Needless to say, I approached the first on-the-air trial with considerable anxiety. You've planned and worked on everything—crystal-controlled signal generator, infinite attenuator for "DX type" signals, cable matching (not perfect yet of course), rf stages with good gain and tuning, mixer ditto, local oscillator chain heterodyning away on 404 megacycles, Hammarlund receiver on the job on 28 megacycles—*but* will it work? It did!

Putting up a 14 element beam on top of one of the five foot sections, and one of the ten foot sections of the Tee Vee masting and a small rotator, with more cable than I like to see connected to it for a total of over 50 feet of RG-8/U, it (the cable) finally wound up on the bench.

The location here is 12 miles North of Boston, Mass., and is exactly 100 feet above sea level, so I call it average. The house is one of the comfortable old-fashioned kind with plenty of stairs! This does elevate the roof though. The beam is about 50 feet above the ground.

The rf stage, mixer, and L.O. chain were plugged together with RG-58/U and connected to a small 150 volt power supply. See Fig. 1. Another coax cable brought the 28 mc over to the Hammarlund and the dials were twirled. Sounded plenty "live." Took the transistor signal source out to the barn. Over S9 but not much directivity on the beam. Kind of like trying to peak a good two meter beam (horizontal) on one of those infernal ground-



BLOCK DIAGRAM 432 RECEIVER

planes that some well-meaning but misguided 2 meter lads get on the air with at times.

At 7 PM I started tuning for real. Soon a carrier came on, with some raucous almost intelligible modulation, clearing up some after a while. About S5. "W1EHF testing, Medfield, Mass. About 25 miles away. (What were you using Frank, transistors?) Incidently, you might be interested to know that that famous "Rhodydendron Swamp" is over 300 feet above sea level.

A little later Frank came on again, this time S7 and over. "W1BU calling CQ 432." Modulation very FB. QRM, low.

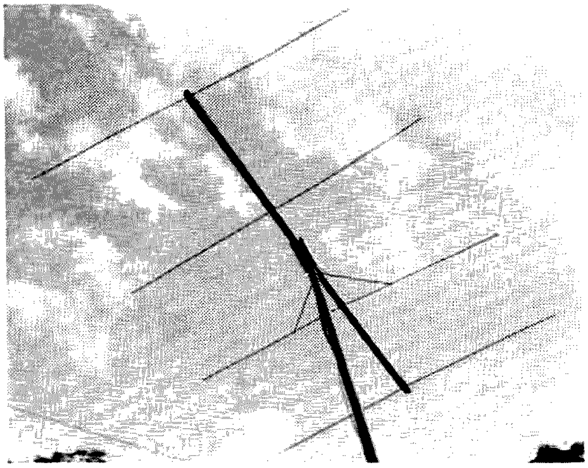
He is soon connected with W1QKA in Nashua, N.H., and gives out with both his own and QKA's kilocycles away from 432. This is the FB kind of info you need on 432. I might say they were mighty close to the black line of 28 mc on the Hammarlund dial also. With this information and putting the beam up N. W., I was able to find WIQKA also. Nashua is some 30 miles airline from Melrose, Mass.

After checking over the various units on the air and listening to as much news as I could at the same time about the 432 mc band, I heard mention of CW signals. Well, why not? On with the BFO Tuning close around 432 mc, I soon heard what I am sure was an SSB station in there, about 432.050. Could not quite identify. Then came the final reward of the evening. Nice CW signal with an exciting DX type QSB on it, "CQ de W1QWJ." He is in Springfield, Mass., down in back of Mt. Wilbraham and associated hills, some 83 miles away from my flat-land location.

The later part of the evening was naturally spent in getting together various transmitter sections. I *will* be on real soon now!

Note the *cost* so far. A 6AN4, a 6AF4, two 12AT7's, a handful of good Hammarlund small tuning capacitors, and a few copper coils and straps.

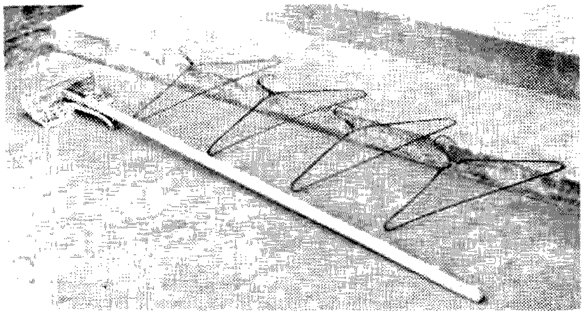
. . . K1CLL



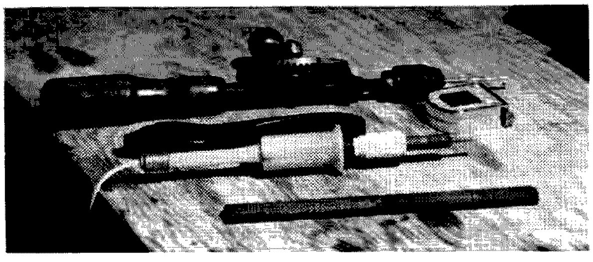
Jim Kyle K5JKX
1236 N.E. 44th St.
Oklahoma City, Okla.

A two meter beam you can build in half an hour at no cost

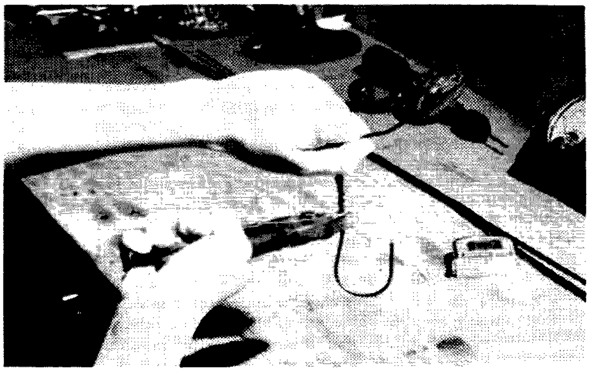
The BH-2



Dissatisfied with the range you're getting out of your halo or ground-plane on 2 meters? And short of the cash you think you need to put up a beam? Try the BH-4 then, for some 6 db power gain (equal to increasing your power by 4 times!). All you need to build one are the parts shown in this photo: four coat hangers and an old discarded broom or mop with a 4-foot handle on it. Cost—nothing. Time to build it—about half an hour.

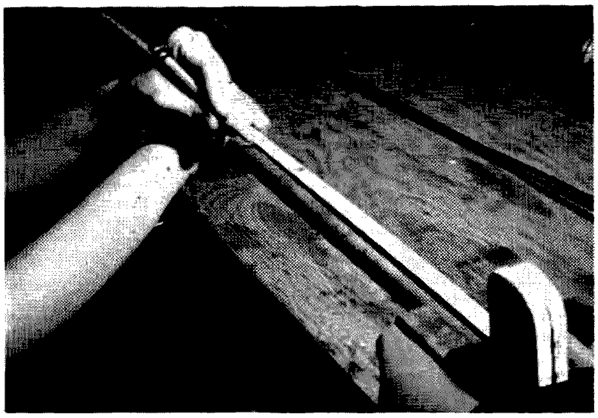


These are the tools you'll need to build your BH-4: hand drill with 3/32-inch bit, pliers, tape measure, soldering iron, and file. You'll also need a hammer and a couple of nails to mount the finished antenna in place atop a second broom handle, and some ordinary insulating tape to fasten the lead-in wire to the supporting mast. Either twinlead or coaxial cable can be used for feedline, but twinlead is recommended since it has far less loss per foot.

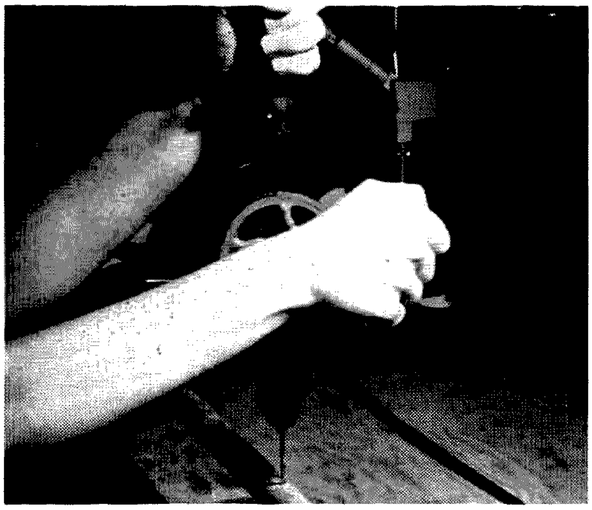


First step is to straighten out the four coat hangers; grab them with the pliers as shown here and twist gently. They will pop apart leaving a kinky portion which is very brittle; on two of them, flatten the kinks with care. On the other two the kinks may be cut off. This saves hangers if the first one breaks!

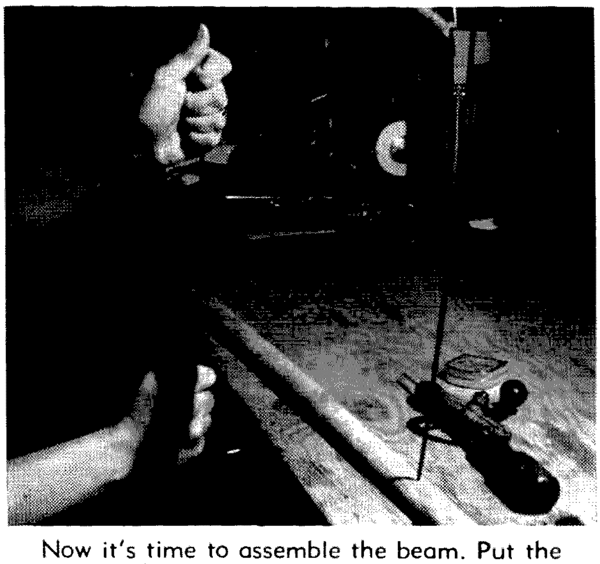
With all four coat hangers straight it's time to cut them to length. The longest one should be 40 inches tip to tip; the next one is 38 inches. The two shorter ones are 36 inches and 35½ inches long, respectively. The photo shows the shortest hanger being cut while the other three lay on the workbench.



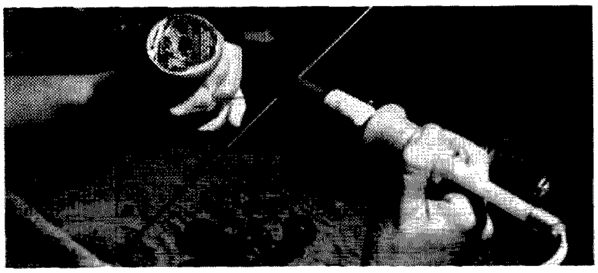
Put the cut coat hangers aside and take the handle off the broom. It must be at least 4 feet long. Mark a hole location 1 inch in from one end, and three more holes spaced 16 inches apart down the length of the handle.



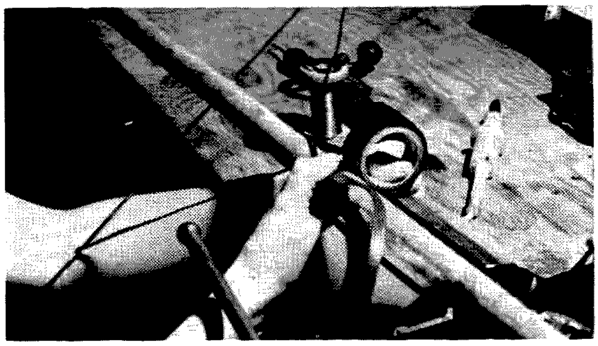
Using a 3/32-inch bit in the hand drill, drill through the handle at each of the four marks. Make sure the holes are all parallel so that the elements of the BH-4 won't be titled cattywampus when it's all done; clamping in a vise as shown helps.



Now it's time to assemble the beam. Put the 40-inch hanger in one of the end holes. The 38-inch element goes in the next hole, the 36-incher next, and the 35¾ inch one goes in the last hole. They should be a tight force fit in the 3/32 inch holes; push them through until the same length of wire sticks out on each side of the handle. If the fit is loose, kink the element right at the mid-point (it can be bent straight again later and the kink will hold it).



Slit the end of your twinlead back about 12 inches. Measure out 6½ inches from the center of the handle, on the 38-inch element, and file through the paint to bare metal. Measure back 7 inches from the element toward the center of the antenna and mark the spot. Stretch the twinlead from this spot to the filed portion of the boom (as shown in the next photo) and mark the length. Strip the insulation from this point on out to the end, wind the wire around the element, and solder it in place. Use only rosin core solder; a hot iron helps much here.



When both wires of the twinlead have been connected, stretch the feedline back as shown here and tape it firmly to the boom. The distance between connections should be 13 inches, and the distance from the taping point to the driven element along the boom should be 7 inches. Use several layers of tape for security.

To mount the antenna, cut two triangles of thin plywood and nail them to a second broom handle. Leave space at the top for the antenna boom to fit. Then nail the antenna boom in place as pictured here and and you're finished. The completed BH-4 should be mounted at least 20 feet in the air. If you can get hold of a TV rotator it's ideal to turn it, but the Armstrong method also works!

David H. Sandrock K7YJF
2741 E. Malvern
Tucson, Arizona

2300 Mc Wavemeters

One of the most fascinating areas of amateur radio for the experimenter is that of the microwave assignments. One large problem looms immediately; frequency measurement. Above 450 mc, the use of open wire lecher lines becomes impractical due to the short distances to be measured and the excessive radiation. The solution to the radiation problem is to shield the lines or to use coaxial or cavity wavemeters. A good mechanical system, employing a vernier for measuring the small distances, is necessary for accurate frequency measurement.

This article describes a coaxial cavity wavemeter for the 2300 mc band that can be built entirely by hand tools found in the average ham shack. While presented primarily as a construction article, it is also intended to show what can be done with simple tools and easily-available materials in the field of amateur microwave work.

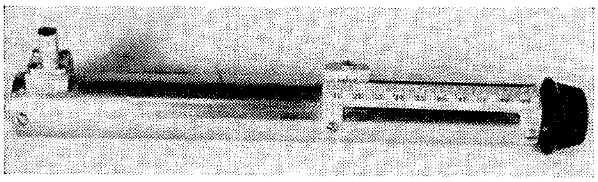


Fig. 1—A 2300 mc coaxial wavemeter which can be built entirely with hand tools. A spinner type knob is preferable for easier operation.

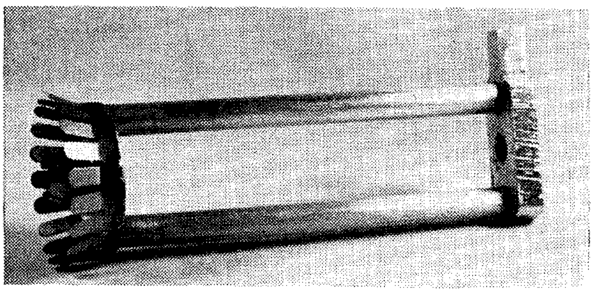


Fig. 3—The shorting plunger for the wavemeter.

If the constructor is careful to do a good job, a fairly accurate instrument will result; one which can measure a frequency difference of approximately 4 mc. At these frequencies this represents about 1.6%. With the wide band of 150 mc available, this allows operation quite close to the band edges.

Construction

All necessary dimensions are given in Fig. 2. The following information will be helpful in choosing materials and building the various parts.

A. Wavemeter Body: This is thin walled brass tubing such as used for sink drains. The nut guide slot can easily be cut with the edge of a large, fine file. Then give a final touchup when fitting the nut (E).

B. Cavity End Plate: All three of these discs (B, C, D) can be cut out of a sheet of the material with a circle cutter using a very slow feed. Drill out the center hole to ⅜″, and use a ⅜″ bolt chucked in a drill as an arbor. Clean up the edges and turn to exact size with a file.

C. Cavity End Plate and Bearing Mount: Aluminum is called out as it is easy to work, but any other suitable material available may be used.

D. Cavity Plunger: After cutting this out, drill the center hole to ⅜″; mount on the arbor bolt and turn down as before. It must be small enough to fit into the wavemeter body after the finger stock is soldered to the outside edge. Then drill the center hole to 19/32″.

E. Nut: Steel is best to use, but is much harder to work than aluminum. The number 13 drill is not the usual one to use for 1/4-20 threads, but it leaves more material for threads than the usual number 8. Be careful

when starting the tap to keep it perpendicular to the nut.

F. Plunger Motion Rods: When fitting these to the plunger and nut, thread the 1/4-20 rod through the nut far enough to extend through the plunger center hold. Then with small amounts of filing on the rods and nut, or shims under the rod ends, the threaded rod can be brought to the exact center of the plunger.

G. Coax Center Conductor: If ordinary copper tubing is used, make sure it is straight and free from small dents.

H. Threaded Rod: This is 1/4-20 threaded rod available in various lengths for homemade U-bolts, etc. File or grind a flat on one end for the outer bushing and knob set screws. File a flat that will be positioned properly for the inner bushing. Let about ⅝″ extend from the bearing on the knob end of the rod.

J. BNC Connector Mount: File to size; file the ⅝″ radius with a half-round file. This is soldered to the wavemeter body. The coupling loop clearance notch can be filed through both pieces after soldering.

K. Bushings: These bushings are to prevent longitudinal motion of the threaded rod. One goes on each side of the shaft bearing.

L. Vernier Holder: Any suitable sheet metal on hand may be used.

M. Scale Holder: Same as above.

N. Coax Shorting Fingers: A source of finger stock is Eimac contact finger stock, carried by Allied Radio Corp; catalog number 42 P 086. This comes in 17/32″ width and is three feet long. The price is high: $5.77. As it takes less than six inches for this project, it would be best if you could get several who were interested in building this wavemeter to go together on the purchase of this item. However, if you can get some small scraps of phosphor bronze or beryllium copper, it is possible to make your own. It need not be silver plated. Solder the inner shorting fingers first, as they will stay in place while the outer fingers are being soldered A good way to hold the outer fingers in place while soldering is to wrap a wire around them and then sweat solder, after tinning both surfaces. Clean off any excess solder.

O. Coupling Loop: When assembled, the loop should extend no more than ¼″ into the cavity. If the loop extends too far, the coupling will be too tight, thereby lowering the Q and broadening the response. If this is so,

[Text continues on page 32]

FIGURE 2a

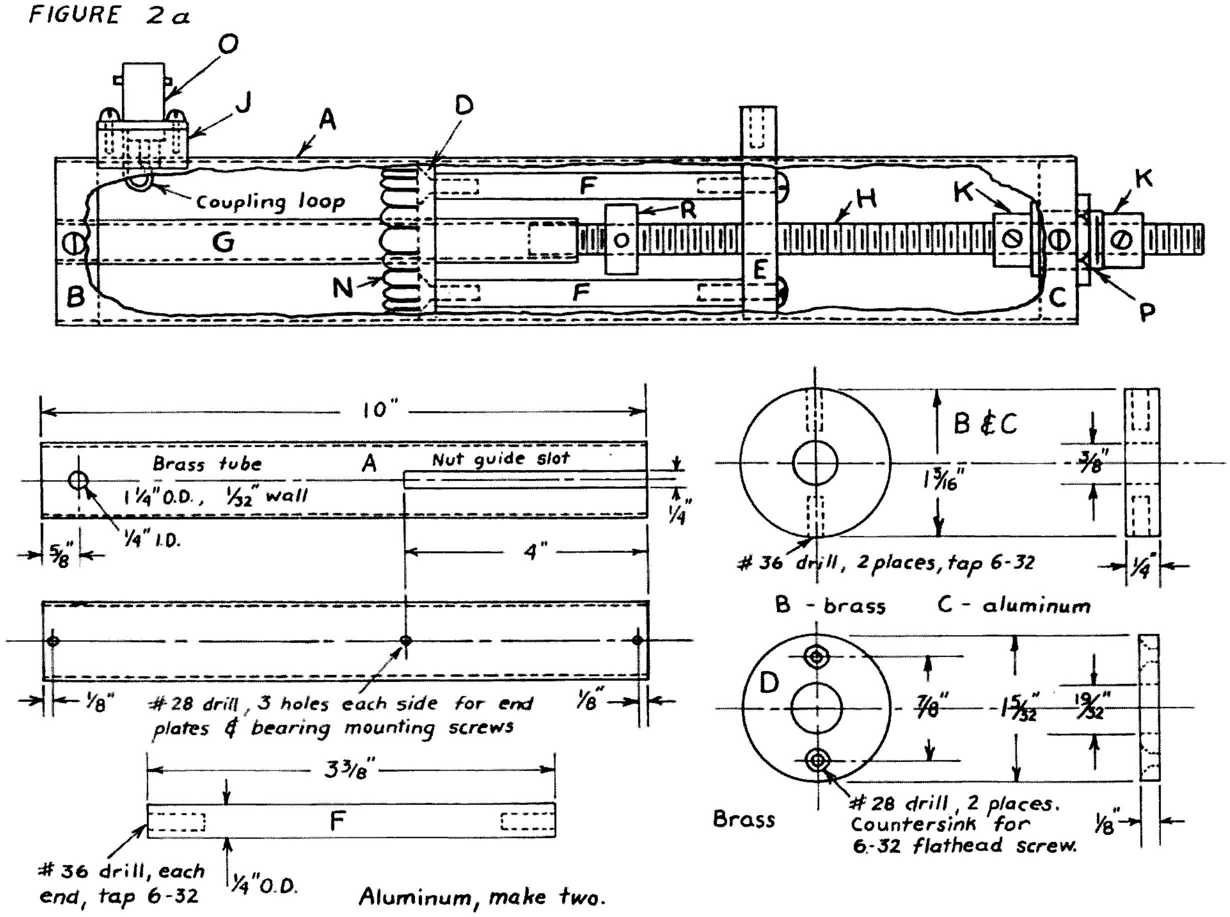
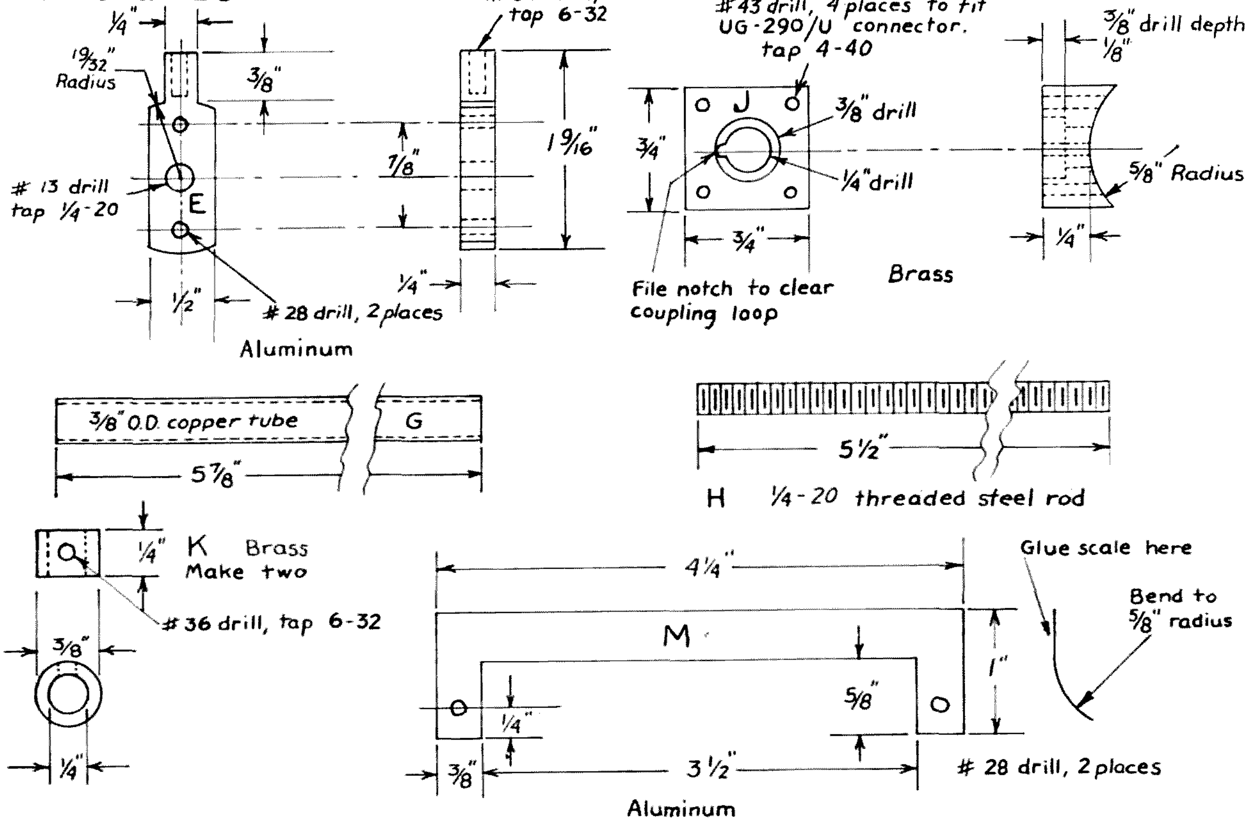


FIGURE 2b



1/4"
19/32" Radius
3/8"
13 drill tap 1/4-20
E
28 drill, 2 places
1/2"
Aluminum
36 drill, tap 6-32
7/8"
1 9/16"
1/4"
#43 drill, 4 places to fit UG-290/U connector. tap 4-40
J
3/8" drill
1/4" drill
3/4"
3/4"
File notch to clear coupling loop
Brass
3/8" drill depth
1/8"
5/8" Radius
1/4"
3/8" O.D. copper tube
G
5 7/8"
5 1/2"
H 1/4-20 threaded steel rod
K Brass Make two
1/4"
36 drill, tap 6-32
3/8"
1/4"
4 1/4"
M
1"
5/8"
1/4"
3/8"
3 1/2"
28 drill, 2 places
Aluminum
Glue scale here
Bend to 5/8" radius

[Wavemeter from page 29]

trim down the loop, or twist it to reduce coupling.

P. Shaft Bearing: An excellent source of bearings for this and other uses such as panel bushings are old potentiometers.

R. Bearing: Any metal on hand may be used. This supports the free end of the threaded rod.

Assembly

Mount the internal parts together as shown in the photographs and drawings. Push the plunger as far down on the coax center conductor as it will go, and insert the entire assembly into the brass tube from the slotted end. Be careful when starting the plunger not to bend the shorting fingers; also watch the end of the slot. When tightening the mounting screws, tighten each one a small amount at a time to keep everything properly centered. After all internal parts are in place, install the BNC connector. Oil the bearings and the threaded rod lightly after assembly. Now try turning the shaft. If there is any binding, try loosening the mounting screws and repositioning the various parts. A troublesome place for binding is the two bushings on the end of the threaded rod. It may help if several small washers are cut from brass shim stock and placed between each bushing and the bearing.

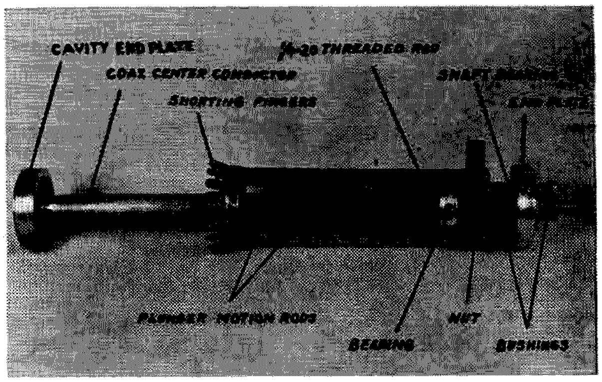
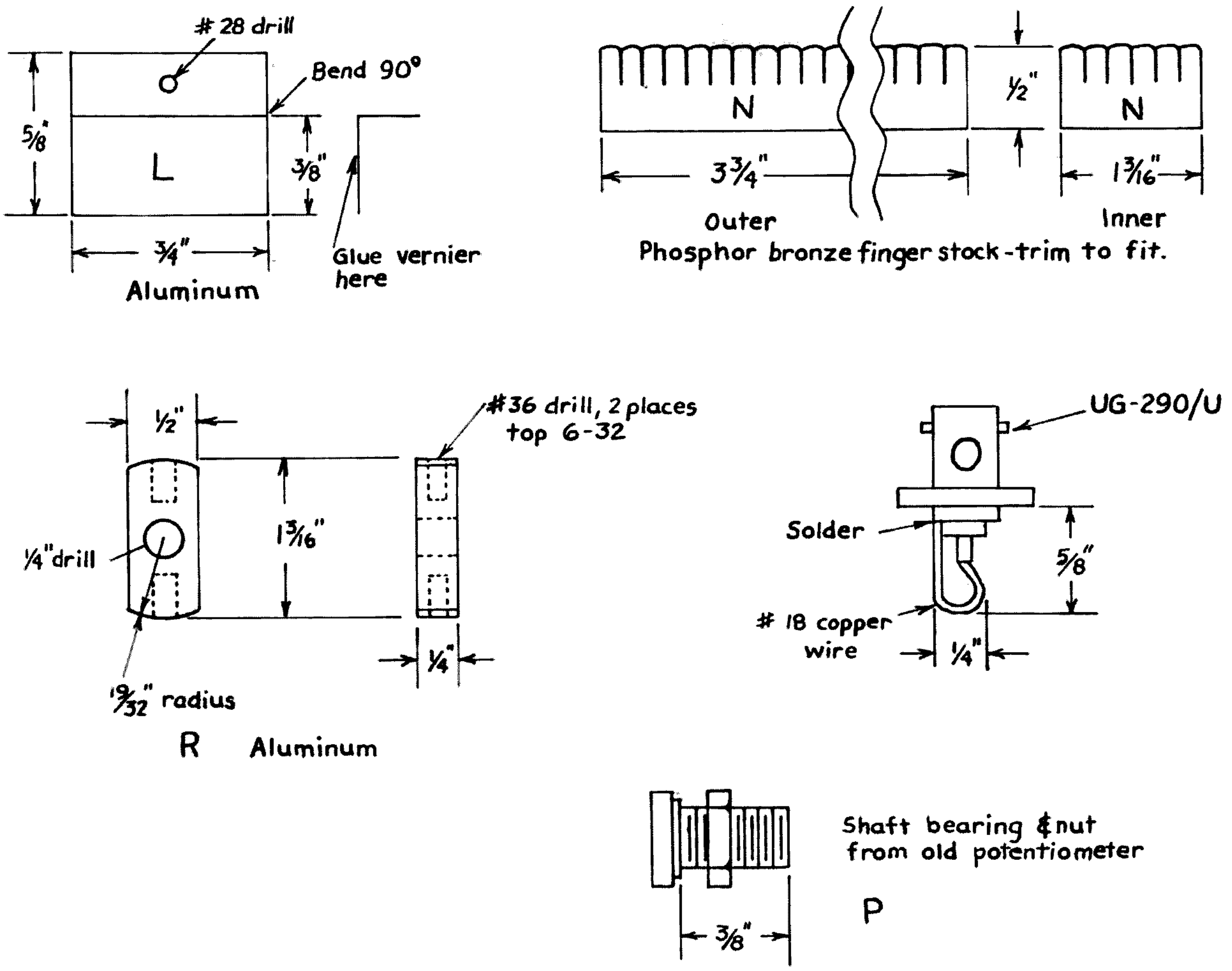


Fig. 4—This view shows how all parts should be assembled before placing them in wavemeter body.

Scale and Vernier Construction

There are two advantages in using a centimeter scale over an inch scale. One is the increased resolution; about twice as good with

FIGURE 2c



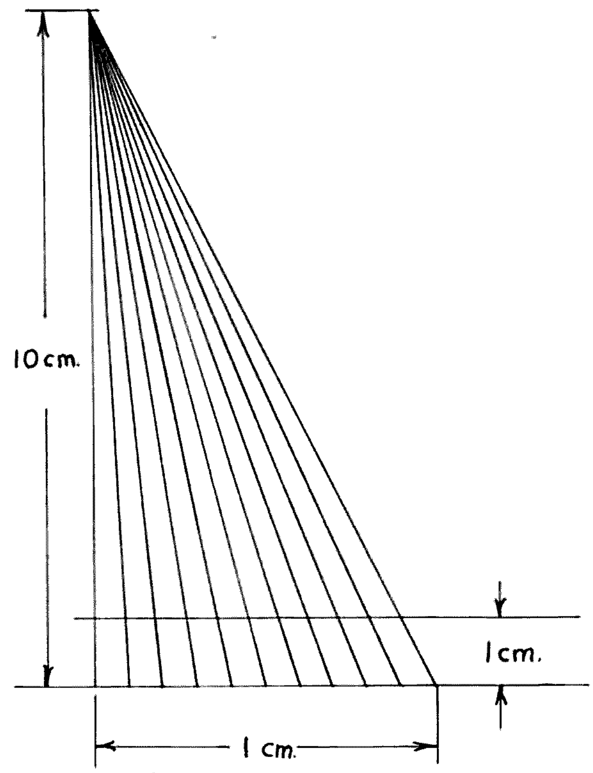


Fig. 5—Vernier construction. Horizontal scale greatly exaggerated for clarity. Use the line one cm. above the base for the vernier scale divisions.

the centimeter scale. The other advantage is the ease of converting readings to frequency. However, it is much more difficult to construct the centimeter vernier because of its small size.

A good source of centimeter scales are the combination inch and centimeter wooden rulers. The centimeter scale is cut off and sanded to size, then glued to the scale holder.

Draw a right triangle with a height of 10 cm. and a base of one cm. Draw a line parallel to the base one cm. above the base. Divide the base into millimeters direct from the scale. Connect each of these millimeter marks with the apex of the triangle (see Fig. 5). Where they cross the line one cm. above the base, they are 0.9 mm. apart, which is necessary for the vernier scale. Construct the vernier scale with these measurements, using a very fine lettering pen and india ink. After gluing this to the vernier holder, cover with clear lacquer or varnish for protection.

If inch scales are desired, the vernier may be drawn in the same manner using inches for all measurements.

A vernier caliper graduated in both inches and centimeters is available from Edmund Scientific Co., Barrington, New Jersey, for $1.80 postpaid. (Catalog number 40,598) This could be modified for use if desired, rather than constructing your own.

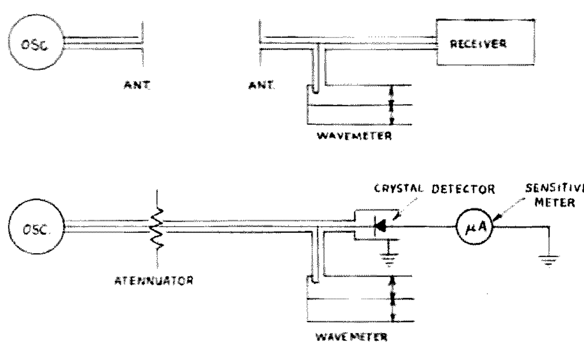


Fig. 6—Schematic of test setups. For attenuator, use a long section of coaxial cable; or vary spacing between the two dipole antennas. At resonance, the indication is a minimum reading.

Calibration and Use

This coaxial wavemeter is an absorption device, like a set of lecher lines. The distance between two null points is equal to a half wavelength. The instrument is therefore self calibrating. To measure frequency hook up the circuit as shown in Fig. 6, either using a crystal detector with a sensitive microammeter (50-100 microamps), or a receiver covering this range such as the APR-5. Apply rf power and adjust the wavemeter for two successive nulls, noting the distance between them in centimeters. Divide 3,000 by twice this amount to get the frequency direct in megacycles.

If several different frequencies are measured, and the reading of the null farthest from the input is used, it can be plotted on a graph against frequency. Now, only these readings need be used for frequency measurement. Do not attempt to use the distance from the input end to the first null as a direct reading without calibration. There are capacitive loading effects which tend to shorten this difference, giving an incorrect reading.

Do not try to measure frequencies higher than 3000 mc with this wavemeter. The diameter of the outer coax is large enough to support other than the dominant TEM or coaxial mode, and spurious reading may result.

If further study along these lines is desired, a bibliography is given which should be very helpful to the experimenter.

1. **Techniques of Microwave Measurements**, C. G. Montgomery, M. I. T. Radiation Lab. Series, 1st. ed., 1947, McGraw-Hill Book Co., N. Y.

2. **Reference Data for Radio Engineers**, 4th ed., 1956, International Telephone and Telegraph Corp., N. Y.

3. **Radio Engineers Handbook**, F. E. Terman, 1st ed., 1943, McGraw-Hill Book Co., N. Y.

4. **Electric Designers Handbook**, R. W. Landee, D. C. Davis, A. P. Albrecht, 1957 McGraw-Hill Book Co., N. Y.

5. **Microwave Techniques**, prepared by M. I. T. Radiation Lab. For sale by Sup't. of Documents, Gov't Printing Office, Washington 25, D. C., for $0.55. (NAVSHIPS 900,028)

New Products

Mobile?

Scientific Associates, Box 1027, Manchester, Conn., have announced some transistorized converters which plug into your car radio and convert it into a short wave receiver. The 40, 80 and 160 meter models are $14.95, others up to six meters are higher. Write for info and prices.

Boxes

If you like to build you'll find a whole line of interesting chassis and cabinets available from Holstrom Associates, Box 8640, Sacramento, California. Send them a card for their catalog 464. They've got some real modern cabinets; worth looking into.

New Mosley Catalog

This new 32 page catalog lists in detail all of the Mosley ham products, complete with specs, curves, etc. They give data on installation, tuning info, and just about everything else you could want to know. Drop a card to Mosley Electronics, 4610 North Lindbergh Blvd., Bridgeton, Missouri 63044. It wouldn't hurt if you mentioned 73.

VHF Tunable Oscillators

E. M. Shulman KØCZD
Chief Engineer
World Radio Laboratories
Council Bluffs, Iowa

Ever build a 6 meter transceiver with a tunable oscillator in the receiver? And listen to it tune half the band in half an hour with nary a twitch of the dial? Like I mean, DRIFT, man?

Not to mention the ANL that lived up only to the first two letters? Like I mean it made noise auto-(and I do mean AUTO) matically, but never heard of that *"limit"* bit?

And speaking of "heard," the local FM stations were what you heard, 150 kc wide in several spots, especially the spots where your neighbor said the DX was?

Well, ol' buddy, welcome to the club. I went through the same thing and would like to pass along some hard earned, useful, and simple information.

First that matter of receiver oscillator drift. My first try used the circuit of Fig. 1. Very simple, practically right out of the good ol' dependable ol' wrong ol' book. You can't temperature compensate this baby! The first one I tested was drifting in the negative direction (oscillator going higher in frequency as it warmed up) even with no TC condensers in the circuit! Sure I heard of P100 positive temperature coefficient capacitors. Very handy, until I plugged another tube, same type, into the socket, and saw the little beastie pull a real broken field reverse and take off for the other goal line, drifting just as fast in the opposite direction. That one could be compensated, but who wants to change the TC condensers every time I change the tube? There must be an easier way.

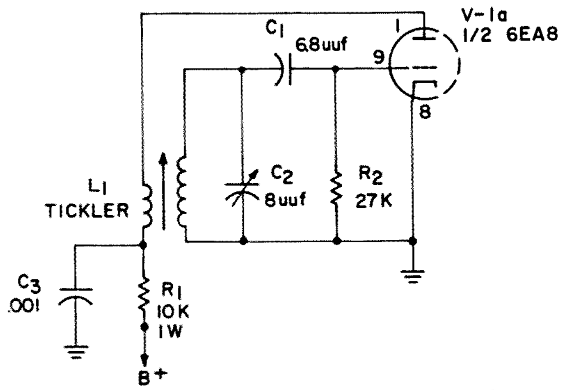


FIG. 1 UNSTABLE OSCILLATOR

And of course there is. Look at Fig. 1. That tickler coil in the plate provides the feedback that tickles the oscillator into oscillating, as the book says. But it also couples the plate structure rather tightly to the fairly Low-C frequency-determining tuned grid-circuit. That means anything changing in the plate circuit has a direct first-order immediate effect on the frequency of oscillation. And how the plate moves inside the tube as it heats up depends on relatively uncontrolled variables such as the amount of stress remaining in the internal welded connections of the tube and whether Mama Minnie sliced the mica spacers straight. It is simply not predictable. In fact, I was unfortunate enough to find half a dozen tubes in our original lab models of the TC-6 transceiver that stayed put very well, resulting in a problem that I didn't know existed until complaints brought about a second look and our TC-6A re-design.

And that's only part of the problem. Here's another. Watch out for slug tuned coils! They drift with temperature changes. In most coils, the slug is in direct metallic contact with the chassis through the adjusting screw and end mounting. This means the slug will be as hot as the chassis, and also will change temperature when the chassis does. And in a transceiver that usually means every time you make a fairly long transmission. Answer? Use a

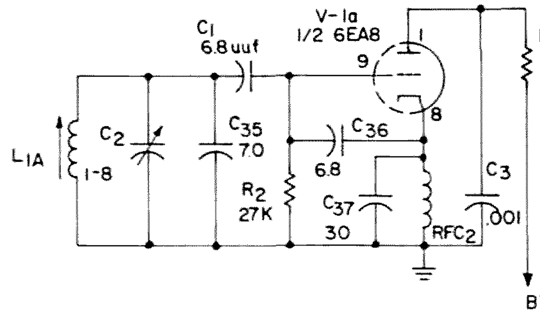


FIG. 2 STABLE OSCILLATOR

slug tuned coil of the type that has a threaded core and a slug that you adjust with an insulated hexagonal tool.* The insulating coil form is pretty good insulation against heat as well as against electrons. Oh, as to why the slug makes the coil inductance change with temperature. It's more than the mechanical expansion of the slug and the resultant change in the physical position; the durn thing also changes in permeability with temperature. Use as little a slug as you can and still have enough adjustment range. You might even want to hacksaw a long standard slug down to half length or so.

Also make sure the coil is well doped with something that will keep the wires in their place, like Q-dope or Liquid-Dope.

And finally, use a circuit that couples the tube as loosely as possible to the tuned circuit. Make any changes in the tube to have as little effect on the frequency as you can. See Fig. 2.

And when you get done, it will drift. But don't despair. It will drift slowly lower in frequency as it warms up, and the drift will be the same even with different tubes.

AND . . . AND . . . as the bearded one might say,

With a TC here and a TC there
Never fear and don't despair
Like a Porsche with a four-speed shift
It'll take a right angle corner without a drift!**

That is, the right choice of temperature compensating capacitors will bring the galloping critter to a hobbled halt. In the circuit of Fig. 2, everything in the grid and cathode circuits is NPO zero-temperature drift except the 7 mmfd from grid to ground, which is TCN-330.

Few other minor points. Plate dropping resistor in Fig. 2 is larger, resulting in lower

* Suitable form with 50 mc coil and slug available from World Radio as part #42-10, price about 75 cents.

** Over 110 MPH Porsche owners refer to it as a "controlled drift" or "Migawd, Virginia, I thought you'd hit the wall!"

plate voltage and cooler less-drift operation. Also, the plate in Fig. 2 is bypassed directly to ground, minimizing its effect on the tuned circuit vastly, compared to Fig. 1 where it is coupled directly to the tuned circuit. The grid-cathode capacitance of the tube,, 3.0 mmfd, is shunted by a 6.8 mmfd NPO condenser which serves three purposes. It decreases the tuning range of the oscillator (or increases the bandspread. Same thing); it makes any change in the grid capacitance a smaller part of the total capacitance, making for less drift; and it decreases the coupling between the tube and the tuned circuit. Make this one as large as you can and still have good oscillation and sufficient coverage of the tuning range. The 30 mmfd NPO from cathode to ground serves much the same purpose.

Now for that ANL bit. See the circuit in Fig. 3. Good ol' series gate self adjusting noise limiter, except I cleverly saved space, weight, and money by using one o' them thar l'il ol' diodes. The handy 1N34, D2.

With a back resistance that made the gate look open even when the instantaneous noise-applied bias said it should be closed.

And that cute l'il diode labeled "high-back resistance 1N54" didn't cure the trouble? It did not!

Explanation? At least one manufacturer's 1N54's are not as high a back resistance as advertised! I use Ohmite 1N54's for D2 now. The back resistance depends of course on what back voltage you measure at, but on a Triplett model 630-APL on the ohms x 100 K scale with about 18 volts applied, the back resistance is above 20 megohms. On a Simpson 260, R times 10 K scale (highest on the meter) with about 7½ volts of battery in the instrument, the needle barely budges off the pin. That limiter works now.

And that last item, those FM broadcast signals. First, how do they get in there, anyhow? Second, how many ways can you get rid of them, and which is easiest?

Well, we better look at some figures now, but we will only add, subtract, and multiply by 2, so if a kook like me with no degree can figure 'em thru, you can too.

Our *if* frequency is 2.1 mc. My oscillator operates on the low side of the signal, which means that from 50.0 to 52.1 I don't hear any ham images, and there is not too much commercial stuff in the 47.9 to 50.0 image range, giving me a nice clean no-birdies receiver over at least the popular first couple of megacycles. Except for those blasted FM stations!

Now the multiplying. Let's say the receiver

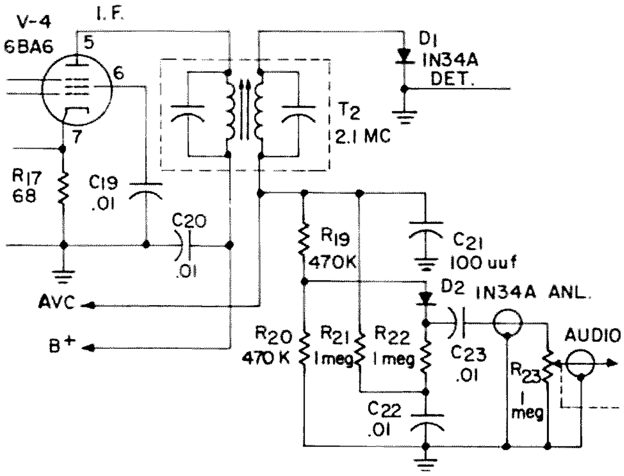


Fig. 3 Series Valve Noise Limiter

is tuned to 52.1 mc. The oscillator is then 2.1 mc lower, or 50.00. The *second harmonic* of the oscillator is at 100.00 mc. If a very strong signal gets through to the mixer on 102.1 or 97.9, it will be converted down to 2.1 and barrel right through the *if*. My Measurements Model 80 Standard Signal Generator says it takes about 300 microvolts to be noticeable. And remember, most ham receivers consider 50 microvolts S 9. This means it takes an S 9 plus 15 db or so signal up in the FM band to give trouble. But brother, when you live in the same town with a 20 or 30 or 50 *kilowatt* FM signal, he *is* S 9 plus 15—and then some.

There are three ways to lock the barn door before the wolf gets to the horse's ear. One: Use enough high-Q tuned circuits at 50 mc so that the FM signal never gets into the mixer. Two: Thoroughly shield the oscillator and bring the output through a low pass filter so the oscillator second harmonic does not get to the mixer and the FM signal has nothing to beat with. Three: Trap out the FM signal with a tuned circuit.

If you are building the ultimate receiver, use methods one and two. Method one means you'll have to gang-tune the rf stages, no broad-banding, which also helps eliminate cross-modulation and images. It is excellent, but expensive and time consuming. Method two will help eliminate *all* birdies and spurious responses, but it also is not cheap and easy.

Method three has one drawback: each tuned circuit will really knock out the interference only over about 500 kc to perhaps 1 mc at the most, but that is usually all that is really needed. And it is cheap. And it is easy. See Fig. 4. Make up a little slug tuned coil. Connect a small NPO condenser across it and grid dip it to make sure it will tune 88 through 108 mc, the FM band. Then hook it up with the condenser in series with the coil, and connect it from grid to ground of the rf stage. For the ultimate in suppression, connect another one from grid to ground of the mixer. On 6 meters, the circuit will look like a small condenser. It will look to be ¾ the size of the condenser used, as the series coil will cancel out ¼ of the condensers' reactance at a frequency ½ the resonant frequency. That is, if you use a 4.0 mmfd condenser in the circuit, it will look like only 3.0 mmfd to the converter on 50 mc. This will mean you'll have to back out the slug or remove a turn or two from the antenna coil or mixer coil with which the FM trap is used

[Continued on page 42]

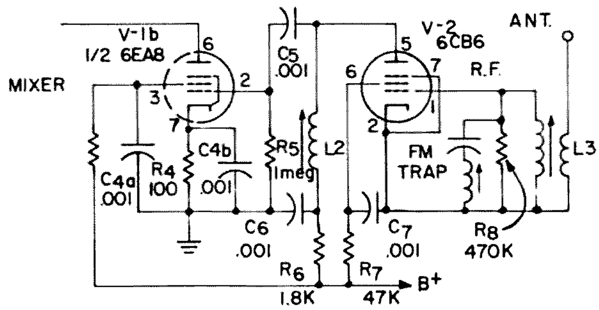


Fig. 4 FM Series Trap in RF Stage

[Oscillators from page 40]

to repeak the converter on 50 mc.

Tune in a real loud interfering bothersome FM signal. Tune the FM trap slug. As you go through the right spot, the FM signal will disappear. Our signal generator says where 300 microvolts at 102.1 was audible before, it now takes about 6 THOUSAND microvolts to interfere. That's about 26 decibels rejection. In practice, it has made the difference between speaker blasting noise over 150 kc of the band and completely inaudible—except maybe if you put a bfo on, you kinda think you might be able to spot a wishy heterodyne where they used to be, unless it's W1FZJ or HOY on forward scatter. And that was with just ONE trap in the rf stage grid.

To summarize: For oscillator stability, watch these four items. (1) Use a circuit which couples the tube loosely to the tuned circuit. (2) If you must use a slug tuned coil, use a threaded form where the slug has no metallic heat-path to the chassis and use as small a slug as possible. (3) Dope your coil so the wire can't shift with heat. And (4) build like a vfo. Or like a battleship. They should be synonymous. Make it physically solid. Good idea to put the oscillator in the *corner* of a chassis, as that usually wiggles less than a spot near the middle.

To make a noise limiter work, if using the series type, make sure the diode has a very high back resistance. Measure the thing on your ohmmeter. If you can't find one in at least the 10 to 20 megohm range on a VOM (don't use a VTVM, it may fool you), use a tube instead of a crystal.

To get rid of FM interference, build a good expensive design with shielded and filtered oscillator and several gang-tune rf circuits, or put in FM traps.

And good luck on your next project!

Note: The FM trap consisting of slug tuned coil wired to 3.3 mmfd NPO condenser is WRL part #43-3, about 75c. The 7.0 mmfd N-330 condenser is WRL #20-21 about 50c.

6 Meter VFO The Easy Way

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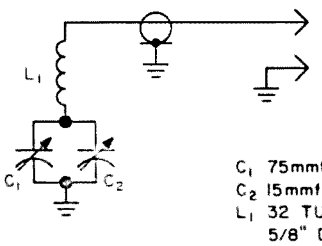
This spring 6 meters opened up and found me with three crystals and 20 watts of rf. Since there was quite a pile-up at 50.25, and the frequencies above 50.5 are a no man's land out here in the land of Channel 2, I became aware of the value of a vfo.

My being a little strapped for funds, completely without test equipment, and having the state-of-the-art conditions (no drift) to comply with, presupposed some pretty stringent conditions: namely—economy, simplicity, and no goofs.



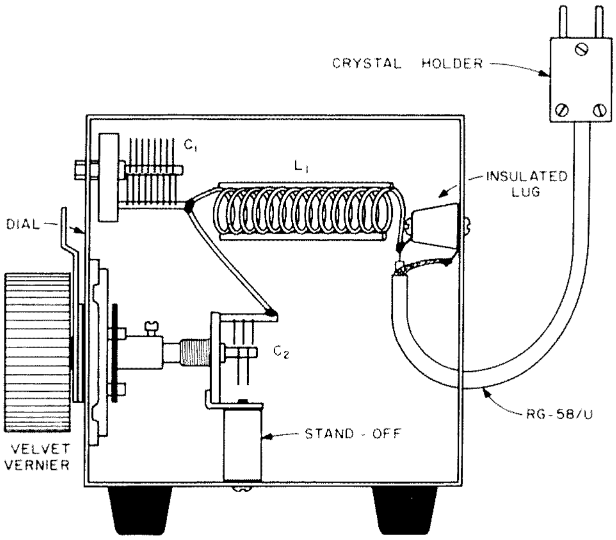
C_1 75mmf AIR TRIMMER
C_2 15mmf VARIABLE
L_1 32 TURNS #20 ENAMELED WIRE 5/8" DIA 2" LONG (*B&W* 3007)

FIGURE 1
VFO CONTROL

A comparison of the more popular vfo circuits and the oscillator in the transmitter brought me to the conclusion that I *had* the oscillator—I needed only to shift its frequency around a bit.

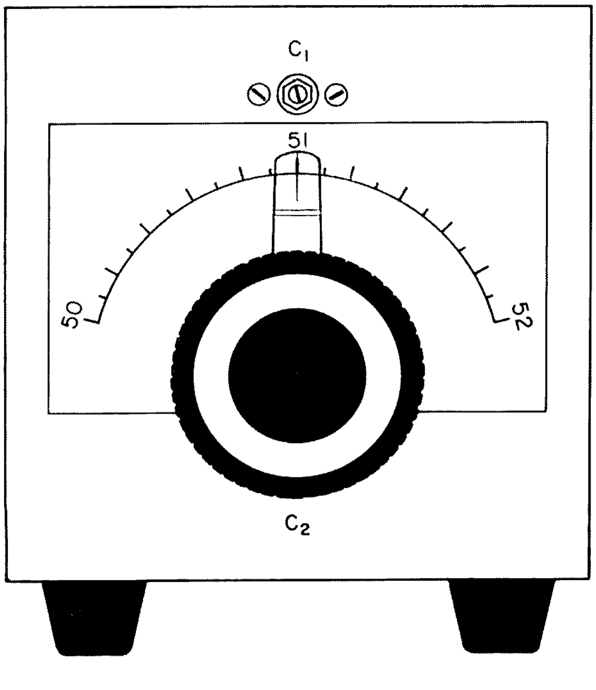
A few sorry attempts at rubber crystals left me with the idea that I had an impossible problem, until I tried plugging a series-tuned circuit at 8 mc into the crystal socket—and it worked! The grid drive was actually slightly higher than I had been getting with the crystals. The advantages of this circuit became immediately apparent. Varying only the oscillator in the transmitter meant that there was very little voltage present in the vfo control, no extra power supply to build, and no tubes to heat and cause drift. All necessary parts—two variable capacitors, a piece of miniductor, a vernier dial, and a cabinet—were in the junk box or could be picked up at the local surplus store for almost nothing.

Construction was quite simple. I used a 4 inch square aluminum box that I had handy because it allowed plenty of room to mount an



old National Velvet-Vernier mechanism. The larger capacitor was mounted above the dial and the small capacitor was mounted on a ceramic spacer from the bottom of the box. The coil is supported at one end by the frame of the larger capacitor and at the other end by a stand-off insulator on the rear panel. The connecting cable is terminated at this point—the center conductor soldered to the coil and the braid to a grounding lug under the insulator. A No. 12 copper bus wire was used to insure good ground connections to all ground points and to the coax. The box was mounted on rubber feet to avoid mechanical vibration. The dial was inked on white paper and attached to the panel under a piece of clear plastic by three small self-tapping screws.

A word of caution to those not experienced in vfo construction. Mechanical rigidity is very



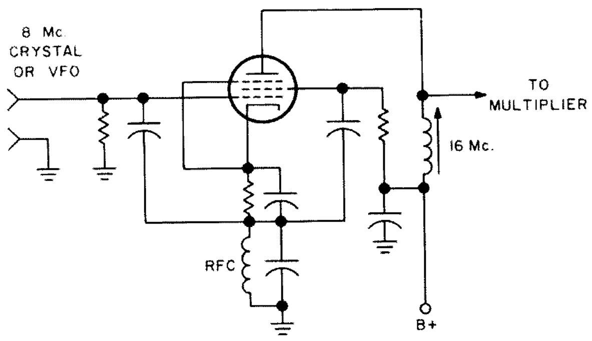


FIGURE 2
OSCILLATOR IN TRANSMITTER

important in the tuned circuit of any vfo. This circuit is subject to capacity between the cabinet and the components. Any movement of the coil or capacitors will result in a frequency shift which can be considerable when used in a circuit multiplying to 50 mc. Good symmetry in placement of the components should also be observed. No. 12 copper wire was used for all connections within the unit to avoid vibration. The box itself is rigid enough to stand all but direct pressure against the sides.

The unit was calibrated against an accurate receiver, first setting it to about 8 mc with C2 fully meshed and tuning CI. Next, the harmonic was picked up at 50 mc by varying C2. A mark was placed on the cabinet at 50 mc and every 100 kc up to 52 mc. (Another setting of CI will be necessary for 52 to 54 mc if you want that part of the band). A dial was made from heavy white paper and inscribed at 50-kc intervals using the spots on the cabinet as a guide. (This is best done using the SPOT control on the transmitter. If you do not have a SPOT control, it is easy to add. Just cut the oscillator out of the keying circuit and apply power with the key up).

The unit has functioned very satisfactorily at my station for more than six months with many hours of on-the-air time. It has been and is being used in conjunction with a Harvey-Wells TBS 50C. I have also tried it with a home-brew transmitter with a similar oscillator circuit. Both transmitters respond very well to the VFO control.

Grid drive to the final of the Bandmaster at optimum frequency (50.25 in this case) is 1.9 ma with a good active crystal, and a shade more with the vfo. At frequencies other than where the oscillator and tripler are peaked, drive is even higher with the vfo. For example, 1.4 vs 1.2 ma on the rock at 50.6 m.

The Bandmaster is a 6AQ5 oscillator-doubler, 6AQ5 tripler and 807 final (running at 30 watts input here). The only thing special about the oscillator is the 50 mmfd capacitor from the grid to the bottom of the cathode resistor. This was added at a much earlier date to improve the response to weak crystals. The oscillator with the tuned circuit in place of the crystal will not oscillate without this capacitance.

The vfo has been used at WA6CDO for six months in many local QSOs and with eight states, Mexico and Canada, and has only once been accused of drift. This complaint came from a local friend and is repeated each time I work him. His receiver . . . ? (I get the same report with a rock in the socket!)

. . . WA6CDO

Low Cost VHF Yagis from TV Antennas

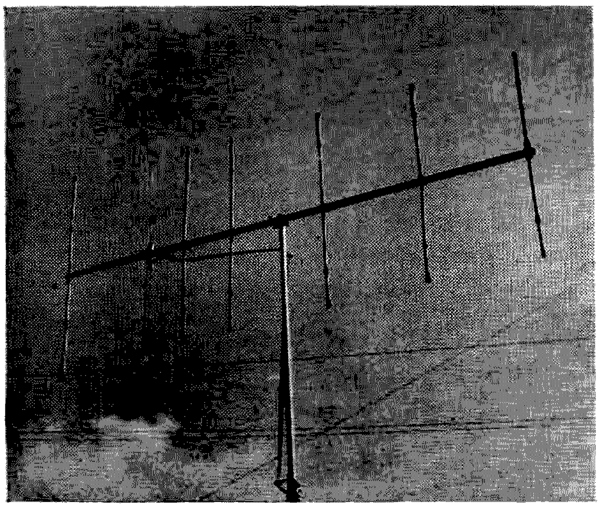
R. F. Van Wickle W6TKA
P.O. Box 4051
Santa Barbara, Calif.

There's only one thing better than a low-cost antenna, and that's a no-cost antenna. But don't let me fool you; unless someone gives you an antenna, there just ain't no such animal.

But, then, someone gave me an antenna. It was a ten-element Channel 10 television Yagi, and it lounged around my garage for two years before I got wise to its possibilities, and then only after my ten-element two-meter Yagi fell down. (It fell down because I was taking it down to fix it. I fixed it, permanently.) Necessity is the mother of invention, and all that.

Now, not everyone has a ten-element Channel 10 Yagi given to him, but the point is this: if you look around you may be able to find a used (mine was well used, in a salt-air climate) tv antenna which will work as well for you on the VHF bands as mine has for me on two meters.

A ten-element channel 10 Yagi is about



W6TKA's two-meter Yagi, made from modified Channel 10 TV antenna.

seven feet long, and has ten elements (naturally) spaced about 8½ inches. As you will note from the sketch, I removed the original driven element and used about six inches of the large-diameter portion of it to extend the boom about six inches so I could space the new reflector (see sketch) 16 inches (0.2 wavelength) behind the driven element, which I fashioned from a length of aluminum clothesline wire. (Sears, Roebuck and Co. catalog. Don't attempt to use tv ground wire which the radio supply houses sell because it is too soft.) I left the first and second directors in their original 8½-inches-apart location, which is approximately what the spacing for these two elements should be in a two-meter Yagi. I then removed every other director, and wound up with a seven-element beam. But with elements much to short for two meters.

Aha! Those elements I removed! As per the sketch, I attached (with 6-32 machine screws, lockwashers and nuts) the necessary additional lengths to make the elements the required lengths for two meters. The seamed tubing cuts easily with sharp tin shears (mine are dull), and I hammered the ends of the elements flat.

Now . . . as to mounting this beast, you will note that I reside in Southern California, where the sun shines 24 days out of the year. Out here in this intellectual wasteland (as some of my Eastern contemporaries are fond of describing this locale) we use vertical polarization on two meters. This means two holes have to be drilled in the boom to relocate the "U" bolt so that the antenna can be mounted vertically. I used a length of dowel (well, an old broomstick, if you must) to mount the antenna on top of a steel mast, since the idea of a metal mast sticking up among the elements did not appeal to me, nor would the antenna have liked it very well.

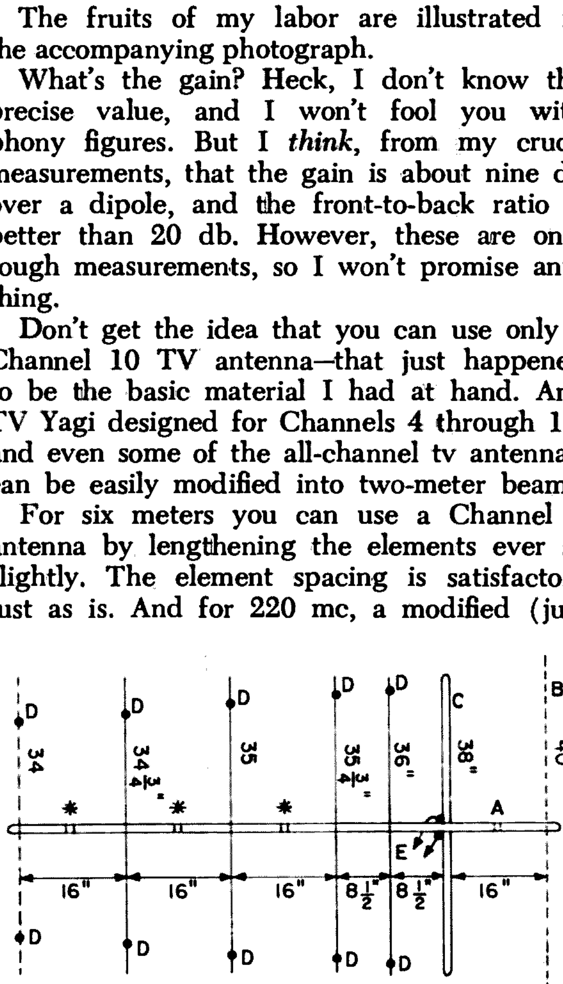
SWR? 2.5 to 1 at 146 mc, 2.0 to 1 at 144.2 mc. The purists will protest, but I think about the small additional losses caused by SWR on a low-loss line (I use a good grade of 300-ohm tv line) and realize that there isn't much to worry about. Besides, I plan to install a simple stub or "Q" section matching arrangement which will reduce the SWR to a much lower value.

The fruits of my labor are illustrated in the accompanying photograph.

What's the gain? Heck, I don't know the precise value, and I won't fool you with phony figures. But I *think*, from my crude measurements, that the gain is about nine db over a dipole, and the front-to-back ratio is better than 20 db. However, these are only rough measurements, so I won't promise anything.

Don't get the idea that you can use only a Channel 10 TV antenna—that just happened to be the basic material I had at hand. Any TV Yagi designed for Channels 4 through 10, and even some of the all-channel tv antennas, can be easily modified into two-meter beams.

For six meters you can use a Channel 2 antenna by lengthening the elements ever so slightly. The element spacing is satisfactory just as is. And for 220 mc, a modified (just



* Original TV antenna elements removed.
A—Original reflector removed and tubing from original dipole attached to extend boom for proper reflector spacing.
B—New reflector, made from two removed elements.
C—New driven element (folded dipole) made from 1/8" aluminum clothesline wire.
D—Portions of removed elements attached to existing elements to make directors proper length. See text.
E—Yagi is fed with 300-ohm TV line, or through "Q" matching section or stub for lower SWR.
All elements, except feed point of driven element, are connected directly to boom; no insulators used.

shorten the elements) Channel 13 Yagi is inexpensive and works splendidly. Even if you have to buy a new TV antenna, you're still money ahead. Consult any catalog (Allied, Newark, Harrison, to name but three) and you'll usually find TV antennas cheaper than VHF ham band antennas. (Of course, if you can con a TV serviceman out of a good, used antenna, so much the better!)

A new, ten-element Channel 10 Yagi will cost under $66.00. A Channel 4 or Channel 6 Yagi costs less than $13.00. That Channel 2 Yagi for six meters costs under $14.00. (Think of it! Ten elements on six meters for $14.00!) And a Channel 13 Yagi for 220 mc will cost about the same as the Channel 10 Yagi.

Compromise? Sure, but it's cheap, and it works.

Eight-over-eight skeleton slot antennas, perfectly-matched Yagis, and all that, are just dandy, but for the ham who occasionally finds himself short of cash, or who simply doesn't want to tie up much money in ham gear, this is an example that there are several ways in which you can have a VHF antenna that will perform quite respectably. I can't help but think that too many of us hams buy nearly all of our gear ready made. I'd like to see more nuts, like me, build or improvise their own gear, especially antennas, about which I am especially nutty.

. . . W6TKA

Swampscott

The Swampscott Convention is still the largest in the country, with close to 4000 in attendance. The big prize this year, a Galaxy Transceiver, was won by R. W. Carlsen W2ZBS of Poughkeepsie, N.Y. and is here presented by Gene Hastings W1VRK, co-chairman of the convention.

Part II

Smaltz for Semiconductors

Robert A. Kidder

In the first half of this treatise we covered the conversion of ac line power to low voltage dc. This half will deal with the voltage regulation of transistor power supplies and also with methods of varying the output voltage. (Those of you who tuned in late can obtain the back issue for a paltry 50 cents.)

Power supply regulation was mentioned several times in Part One. Regulation refers to the ability of a supply to maintain a constant output voltage in the face of a varying current drain. In cases where the dynamic load is light, or where Class A loads (the average current drain is essentially constant) are involved, voltage regulation isn't a problem because the amount of the current variation is small when compared to the total load current. Therefore, the voltage change from minimum load to maximum load will be small also, especially if the power supply impedance has been kept as low as practicable. The voltage regulation is then said to be good, or at least adequate.

However, when the load variation is large, or when the current drain is intermittent, as with Class B loads, the regulation of the supply can be something of a headache. The reason for this is that at high current levels the impedance of the supply becomes an appreciable fraction of the load impedance. As the load current increases due to a decrease in the load impedance, the supply voltage begins to drop across the supply itself and the voltage available to the load goes down as a result. The regulation under these conditions is poor, and among other evils it can cause signal distortion. In these circumstances it behooves us to find a method of stiffening the power supply.

Figure 5A shows a simple method of stabilizing the output voltage for light loads. The action of this circuit is similar to its gas tube counterpart, except that there is no initial voltage overshoot. Once the breakdown potential of a zener is reached, the voltage remains constant at that point. The procedure for selecting the dropping resistor, R_D, is the same as for gas tubes, and it consists of taking the difference (in volts) between the filter output voltage (E_s) and the zener operating voltage (E_r) and dividing it by the maximum current (I, in amps) at which regulation is to be maintained. This current figure should be about 10% in excess of the actual maximum anticipated load current at which regulation is desired, so that when this point is reached, enough current will still be flowing through the zener to keep it operating solidly beyond the break in its characteristic curve (known as the zener knee). This will insure proper regulation at the desired maximum load current. The formula which describes the value of the dropping resistor is $R = \frac{E_s - E_r}{I}$. The answer will be in ohms.

Notice that the zener diode appears to be wired backwards in this circuit. It's quite correct, however. The zener action occurs when the inverse voltage capability of a diode is exceeded, and its junction breaks down. Any junction diode will behave like a zener under those conditions, but zener diodes do it better. For what it is worth, any junction diode will always break down at the same voltage, but this voltage varies widely from one diode to another, even among the devices of the same

type number. If you can determine the breakdown point of a given non-zener diode, it can be used as a zener at that voltage.

Zener diodes have been covered quite thoroughly in the November, 1962 issue of 73, as well as in the whole spectrum of electronic publications, from the most esoteric engineering journals to the most elementary of hobbyists' magazines. The writer, therefore, chooses to make only a few plain-text statements contrasting them to gas regulators. First of all, zeners are available in a staggering assortment of voltages and power ratings, from about 3 volts to several hundred volts, with power dissipations ranging from precision reference cells rated at a few milliwatts to big, woolly monsters of 100 watts or more. Gas tubes, on the other hand, can be had only in four or five standard voltages, with a maximum dynamic current range of 35 milliamps.

The biggest zener diode ever encountered by the author was a 60 volt, 50 watt unit, and it was only about one eighth of the size of an OA2, which is a gas tube in a seven pin miniature envelope. Furthermore, that big zener required only a single ¼" hole for mounting. Texas Instruments, among others makes a series of 400 milliwatt zeners that are smaller than half-watt resistors, and they're reasonably priced at less than three dollars each. Gas regulators, in this writer's opinion, come away a poor second to zeners in regard to physical size, electrical characteristics circuit simplicity, and general utility.

While it is entirely feasible to install a 10 volt, 10 watt zener diode in a supply and get a

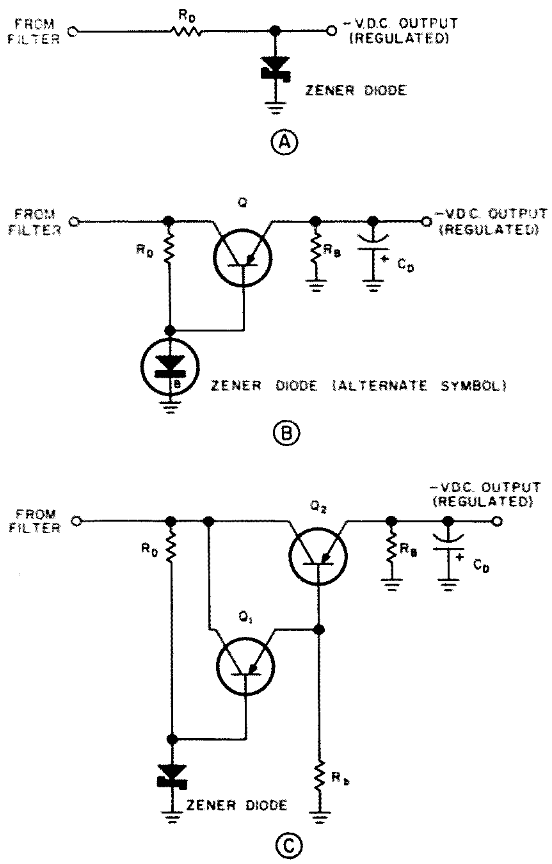


FIGURE 5

10 volt output that will stay in regulation out to one amp, the cost of that 10 watter may knock your wallet out of regulation. Figure 5B shows a series regulator circuit that will multiply the current rating of an inexpensive, low power zener by a factor equal to the beta of the power transistor, Q. The transistor itself need not break you bank, either. It can be one of the less-than-a-dollar variety offered by most of the major mail-order electronics supply houses. These units are generally culls from the production lines of the Big Names, and they have usually been rejected for high collector to emitter leakage or for low beta. In this application, both faults can be tolerated. High leakage normally engenders temperature instability in a transistor amplifier and increases the possibility of thermal runaway, but in this circuit the transistor is connected as an emitter follower, and thermal runaway is therefore impossible.

Low beta can be compensated for by using a second transistor in a Darlington configuration, as shown in Figure 5C. Q1 can be any unit that is capable of handling the base current for the power transistor, Q2. The base current is equal to the current flowing between the collector and the emmitter, divided by beta. In the case of Q2, the collector to emitter current is the sum of the currents drawn by the external load and by the bleeder resistor, R_B. Q1's beta needn't be anything to write home about, so Q1 can be bargain basement special, too. Beta for the combination will be the product of the betas of the two individual transistors. For example, if Q1 is a medium power unit from the cutrate bin at the corner drug store, with a beta of 25, and the power transistor, Q2, is a mail-order mongrel with a beta of 10, the compound beta will be 250.

The extra resistor, R_b, is a ballast resistor which helps to minimize any effects of transistor leakage. Its value isn't critical; it can fall between 1K and 10K, with higher leakages taking values toward the low end. As mentioned before, R_B is a bleeder resistor, which should be chosen to draw perhaps 5% of the supply's maximum output current. The capacitor, C_D, is intended mainly for decoupling the circuits powered by the supply, and its value ought to be at least 50 microfarads.

In addition to extending the current capability of a low power zener diode, this type of regulator circuit provides two other advantages: it reduces ripple, and it lowers the output impedance of the supply. Since the flow of current through a transistor is independent of the collector supply voltage and is determined mainly by its base current, variation of the collector voltage, caused by ripple, will not induce any variation in the current flowing through the device, as long as the ripple low point doesn't dip below the voltage level at the emitter. Any hum that does appear in the output will be a result of ripple being present at the base of the transistor and of collector to emitter leakage. Obviously, in a supply with electronic regulation of this sort, filter requirements can be less rigid. The filter circuit need only be heavy enough to do a really good job on the base supply for the series regulator, and the transistor itself will do the rest.

The other bonus, lowered output impedance, owes to the fact that the output impedance of an emitter follower is approximately equal to the impedance of the base circuit divided by the beta of the transistor. Referring again to Figure 5C and applying the values of beta given previously, the output impedance of the regulator would come close to the impedance of the zener diode (about 20 ohms) divided by the compound beta of the Darlington connected transistors; this was 250 in the example. The resulting output impedance is in the neighborhood of 80 milliohms. Looking back through the emitter of Q2, R_D would appear tc be in shunt with the zener, and R_b would appear to be in shunt with Q1. Since the resistance of each is several hundred ohms, theii

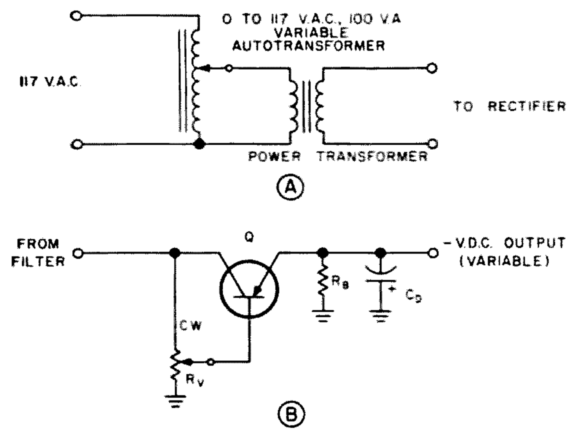


FIGURE 6

net contribution toward lowering the overall output impedance is small. Thus it can be seen that the use of seires regulator is a most convenient method for keeping down the output impedance of a power supply. In high current supplies (half an amp or more) their use is practically mandatory. In general, series regulators pay their own way, and then some.

There are many ways to control a series regulator in addition to simply referring it to a fixed voltage, as has been done here. There are error sensing shunt amplifiers, zener referenced differential comparators, and even AC-coupled hum amplifiers which feed the ripple back out of phase and make it possible to eliminate normal filter circuitry altogeather. The author does not wish to slight the more technically competent readers, but he desires only to impart working knowledge of the basic techniques in semiconductor supplies. Adequate coverage of the more exotic methods of making a supply sit up and talk would take far more space than your writer feels inclined to fill. In any case, outside of laboratory use and other critical applications, their value in garden variety, general purpose power supplies seems doubtful.

The final aspect of this dissertation is variable voltage outputs, such as would be useful in general purpose bench supplies. Probably the simplest solution for this is to operate a fixed voltage supply from a variable autotransformer inserted between the line and the primary of the power transformer, as shown in Figure 6A. Light duty variable autotransformers can be obtained for as little as three dollars from surplus outlets. This method should not be employed if the supply has a zener diode or other reference element in it, however.

Figure 6B illustrates a kind of series regulator that is controlled by a pot, R_v, instead of a zener. Strictly speaking, it's not a regulator at all, because it has no fixed reference. It's really a sort of step-down resistance transformer (imagine that!). It makes the pot look like a much lower resistance than it actually is, exactly the same way as the series regulator divides down the impedance of the zener diode in its base circuit. The pot is used to establish the output voltage, but only the transistor's base current is drawn through it. The load current is drawn through the transistor itself. If the resistance of the pot is such that at least fifteen or twently times the base current is drawn through it, the regulation of the supply can be made surprisingly good for a circuit with no standard of reference. This little jewel, by the way, can be strapped across a battery pack to yield a variable voltage output without the necessity of dumping great gobs of battery-sapping current down a low resistance divider.

Neither the variable autotransformer approach nor the series transistor method can be considered as capable of producing truly stiff variable voltage sources. Figure 7 shows a basic circuit which gives a variable voltage output that can be regulated to better than 1% at any point in its range. It is quite similar to the circuit of Figure 6B, except that the pot is supplied from a zener diode stabilized source. In choosing values for the dropping resistor and the pot, be careful to insure that the voltage at point "Z", which will be determined by the divider action of R_D and R_v alone, is higher than the zener voltage. If it isn't, the zener won't be driven into conduction, and the output voltage won't be regulated. If the voltage at point "Z" is greater than the zener's break-down potential, it will be pulled down to the regulated level when the zener goes into conduction, and everything will be fine and dandy. The regulation of this circuit can be held to very tight limits if a high beta power transistor, or a Darlington hook-up, is used. This will reduce voltage variations at the arm of the pot, caused by the base reflecting changes in the load current which is flowing through the transistor. The higher the beta of a transistor, the less its base will be affected by changes in its collector to emitter current. Running the zener well up into its current range will allow the use of relatively low values of resistance for R_D, which in turn will permit lower re-

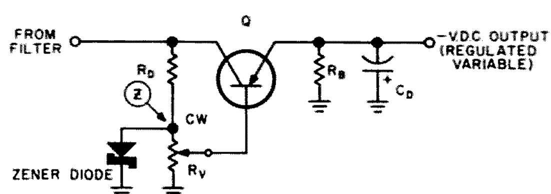


FIGURE 7

sistances for the pot. This will further minimize any changes at the base of the series transistor.

Needless to say, you should be careful not to exceed the power ratings of the transistor or the zener diode. The maximum permissible zener current can be determined by dividing the power rating of the diode by its operating voltage. If its dissipation is stated in milliwatts, your answer will come out in milliamps; if its power is given in watts, the answer will be in amperes. Multiplying the voltage being dropped across the series transistor by the current being drawn through it will yield the power being dissipated in it. It can be seen that the lower the voltage output, the less current can be safely drawn through the transistor without exceeding its power rating, because the lower the output voltage is, the more voltage is being dropped across the transistor. Something else to consider is a transistor's power handling capability goes down as its case temperature goes up. Therefore, if you want to get the most out of the series transistor, mount it on a "cold plate", otherwise known as a heat sink. This can be a six inch square of ⅛ inch aluminum plate which is electrically insulated from the chassis. This is necessary because the collector terminal of a power transistor is its case. The transistor can be mounted on the chassis itself, if a mica gasket is used between the case and the chassis, and the mounting screws are insulated with fiber "shoulder" washers.

This just about wraps up the de-lux, econ- ɔmy-sized tour through the realm of transistor ɔower supplies. An apparent omission, fusing, ;hould be cleared up before everybody goes ıome, though. Fuses should be selected with :he thought of protecting only the power trans- ormer and the rectifiers in the event of a catas- rophic short. Attempts to fuse a series regula- or will not bear much fruit, because in the ɔresence of a massive overload, the power ransistor will beat the fuse to the punch. An ·xception to this might be when a 15 amp ıouse-tilter is being protected by a ¼ amp, ast-blast fuse in series, but this is rather like lriving thumb tacks with a sledge hammer. If easonable caution is exercised when making onnections to the supply, and when poking bout in circuits powered by it, no fears need ·e harbored. Trial circuits can be fired up ıitially through a low value series resistor nd an ammeter to make sure that there are o shorts due to wiring errors or design mis- alculations. Once this has been done, the ɜries resistor can be removed, and you can roceed with setting up the circuit, or whatever lse it was that you had in mind.

All of this is not to say that series regulators can't be protected; they can be. The usual practice, in many kinds of expensive transistorized gear and in laboratory supplies, consists of a circuit which senses the dropping voltage caused by an impending short and shuts down the whole works until the short is cleared. Most guard circuits of this type can close a supply down inside of a few microseconds, once they're triggered fuses, by comparison, take practically forever to blow. Forever, in this instance, is often a tenth of a second, or even longer. The guard circuits should be classed as exotic extras that are beyond the scope of this article. They can be tricky, and may of them require fancy components not readily obtainable by most amateurs or hobbyists. The author recommends caution as a reasonable and inexpensive substitute.

In summing up this whole business, a low voltage, high current dc supply (or two) operated from the ac line is a handy item to have around the shack. Among other uses, it can run all that transistorized gear that you've been building lately, so that the batteries will be fresher when you have to use it away from the power line. If the said equipments require various voltages, build several regulators and run them all in parallel across the output of the supply. This will give "plug-in" convenience at the bench for the different pieces of gear. Another point to consider is that batteries wither and die, even when they're just sitting there and taking up space on the shelf. Ac operated power supplies have an infinite shelf life. Break the battery habit. Build yourself a couple of soothing, line-operated power supplies and feel relaxed, they're milder, much milder.

. . . Kidder

Letters

Dear Wayne,

I fully agree with the proposals of the IoAR to assist for the increase of ham activity and the number of hams in other parts of the world. I also agree with the proposal to keep the concerned authorities in other countries well informed about our hobby, its service to the society, etc. Our cause will more effectively be served by doing extensive public relations all over the world, rather than just trying to increase the standard of American hams.

In India, with a population of 430 millions, we have about 340 licensed hams out of which only 25% are active on the bands. Our low standard of living makes hamming a very costly affair even for the average enthusiast. This is not helped by import restrictions which make for a high cost of components. When this is the case in a country like India, it should be much worse in the countries of Africa, the Middle East and South East Asia.

G. V. Sulu VU2GV
Bangalore, India

Sir:

In the February issue of 73 the article by J. R. Fisk WA6BSO on the portion of soil treatment he should have listed common rock salt first in the order of importance of various chemicals.

There's nothing wrong in digging the basin right near and around the grounding rod. The same dimensions can be used 1 foot deep 1½ foot around the rod. Add 5 lbs of common rock salt and 12 quarts of water. More water would be beneficial.

Corrosion caused by chemical action on electrodes is not serious. Rods in the ground for about 5 years have been removed with little or no corrosion observed. In one case, chemicals inclusive of copper, iron and ammonium sulphate as well as sodium chloride were used for copper, galvanized iron, and plain iron electrodes. Corrosion due to electrolytic action would be more serious if the grounds were required to discharge direct current.

Treating the soil at the rod is more effective.

Joseph D. Gagne W1ZVF

The Ever-useful T-Pad

Jim Kyle K5JKX
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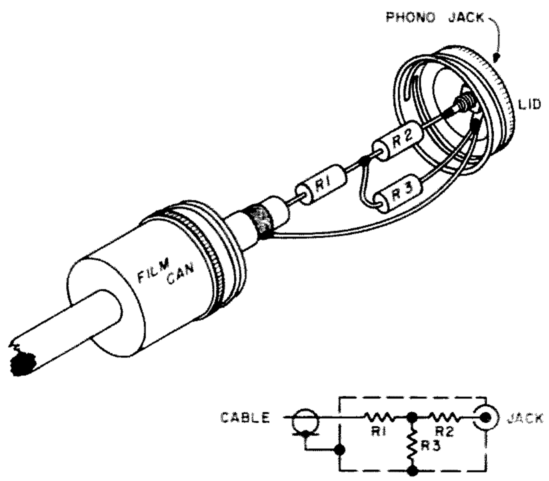
Oklahoma City, Okla.

Most of us have transmitters; let's hope that an equal number of us have receivers also. Antennas and microphones are usual station accessories, with a few determined diehards here and there clinging to the trusty old key. But how many of us have much in the way of test equipment?

Now and then somebody pops up with a VOM, and occasionally you can even find an operator who uses a scope. But the kind of special-purpose test gear you find in a well-equipped laboratory is almost always absent in the ham shack.

Which is more or less as it should be, since we're hams, not laboratory technicians. But with the present trends toward VHF, at least some specialized test gear is necessary. Otherwise, the regular station equipment can't be tuned for maximum performance.

One of the simplest such items is a noise generator, for getting the VHF receiver in perfect tune. This gadget has been described many times before, so we won't repeat it again—but we do have something which transforms the usual noise-generator lashup from a so-so item to an instrument capable of laboratory accuracy.



T-Pad construction details

Before going into detail, let's look at the normal method of using a noise generator: you connect the generator to the antenna input, tie the converter to the receiver, turn the avc off, connect a voltmeter to the detector load resistor in the receiver (or put an ac voltmeter across the speaker leads), and measure the voltage produced by just noise. Then you turn on the generator and adjust it for a 3 db (1.4 times the voltage) increase in output; the object is to achieve the 3 db increase with the minimum amount of current flowing in the noise generator.

However, this technique of using the noise generator is pretty sloppy, since it assumes that the receiver's detector is absolutely linear for small signals—and this assumption is almost always incorrect.

A far better technique is to hook things up just as before, except now you place three T-pads in the line between converter and receiver. The T-pads on each end of the string serve merely to clamp the line impedance at 50 ohms, but the one in the center is built for precisely 3 db loss.

Now take the 3 db pad out and take your reading as before with the noise generator off; you don't have to turn off avc or hook up a voltmeter. The receiver's S-meter can be used instead, since we're not measuring anything with the meter itself. It merely serves as an indicator so we can come back to the same point.

Then replace the 3 db pad in the line, turn on the generator, and crank it up until you get the same meter reading as before. Since you now have 3 db of added loss between converter and receiver you must have increased the noise power output of the converter by that same 3 db, and you could care less about the linearity of the detector!

This whole method is far from new, but previous descriptions of it have left something

to be desired in the way of telling how to build the T-pad. The gadget is so simple that it must have seemed obvious to previous writers—but it does have its tricky points too.

For instance, since a T-pad consists merely of 3 resistors, it is pretty easy to just wire them up by their leads. But they are hanging in the receiver antenna lead, and present-day receivers are rather sensitive. If you happen to find a 20-meter signal, it's going to foul up your measurements!

One of the quickest ways to sidestep this problem is to shield the pad against all outside influences—but how do you shield anything so tiny?

The answer here is to use discarded 35-mm film cans, which all photographers who shoot 35-mm cameras have in abundance. The Kodak kind seem to work best. This type has a threaded cap, with a flat spot in its center just right for drilling a ¼ inch hole to take a single-hole-mounting phono jack. At the other end, a ⅜ inch hole can be punched and lined with a rubber grommet for coax cable to enter.

Next step is to place the jack in the hole in the lid, with its solder lug on the inside (be sure to clean the paint so that a good electrical contact will result). The T-pad can be assembled as shown in the drawing with shortest possible leads, and supported by its lead connecting to the jack. Thread a short length of RG-58 through the grommetted hole, and connect its center conductor to the other lead of the pad; the shield and shunt lead of the pad connect to the solder lug of the jack.

All that's left is to wire-brush the threads on the film can for good contact, and screw the lid down tight. Presto, a shielded T-pad. A phono connector should be put on the free end of the cable.

You can make up a whole bunch of these in various loss values, and get virtually any amount of loss you want by stringing them together. And this has a whole lot more use than just using with a noise generator . . .

For instance, when you want to test an antenna, arrange for a steady signal, strong enough to register on your S-meter with the back of the antenna pointed at it. Then swing the antenna in small steps, and bring the S-meter back to the same reading by inserting additional loss between converter and receiver with the T-pads. The difference between this and S-meter indications may amaze you.

Or if you are called upon to measure the difference in signal strength between two stations, the same approach can be used. Note the S-meter reading of the weaker, then knock the stronger one back to the same reading by putting T-pads in the converter-to-receiver line. Read the db off the pads and add them up.

You can even use this in place of an S-meter if you really want to know the signal-to-noise ratio of an incoming signal with accuracy; take a reading on noise, then knock the signal back to the same point. Total up the db, and there's your answer.

Though resistance values in the pad must be precise for absolute accuracy, the pad has an inherent tolerance of small errors and you should have better than 2 percent accuracy if you use 5-percent resistors. Specifically, a 10-percent error in the resistance value of any one arm produces less than ¾ db error in the pad loss, and less than 4 percent error in impedance. Using 5-percent resistors would, of course, cut these error limits in half.

If you want to follow the approach of using a string of these pads for all purposes in the shack, it's best to make them up on a "binary" approach since this gives you the maximum number of db values with the minimum number of parts. A basic assortment might be two 1 db pads, and one each of 2 db, 4 db, 8 db, 16 db, and 32 db. Using them in series in various combinations, you can get any whole number of db from 0 to 64, which pretty well covers the range of values you may ever need. For an example, to get 50 db you would use the 32 db pad, the 16, and the 2. For 60 db, you would use the 32, the 16, the 8, and the 4.

If the ability to increase loss in 1 db steps seems a bit exotic to you in view of the fact that 3 db is only half an S-unit, then you can use a binary progression in 3 db steps; this takes one 3 db pad, one 6 db, one 12 db, and one 24 db. The range is from 0 to 45 db, 3 db at a time.

For clamping a line's impedance, it's a good idea to use at least a 3 db pad and a 6 db unit might be even better. The lower-loss pads

SOLDES

Si certains numéros de 73 vous manquent, voici une excellente occasion de complèter votre collection. Pour 5 F au lieu de 8, nous vous enverrons 4 numéros à votre choix (postérieurs à février 61). Si vous désirez recevoir une année complète nous vous enverrons toute la série pour 13 F alors que le prix normal est de 20 F. (A la rigueur nous accepterons 14 F au lieu de 13 si vous êtes superstitieux!)

Pour vous faciliter les choses, vous pouvez virer la somme dûe à F2 BO.

J-P CATALA, CCP 9372-41, Paris.

GELEGENHEIT

Falls Ihnen einige Exemplare von 73 fehlen, bieten wir Ihnen die Gelegenheit, diese Lücke auszufüllen. Für 4 DM statt 6, 40 DM können Sie 4 Nummern Ihrer Wahl erhalten (ab Februar 1961). Ween Sie einen ganzen Jahrgang wünschen, können wir diesen für 10 DM anstelle 16 DM übersenden.

pads may not have the ability to swamp out impedance variations on their other sides.

About all that's left to make this complete is a chart of resistance values for various loss figures. Here it is; all are for use with a 50 ohm line; to use at any other impedance, multiply these values by the ratio of the new impedance to 50 ohms:

-OSS AMOUNT	R1, R2	R3
1 db	2.7	430
2 db	5.6	220
3 db	8.2	150
4 db	11	100
6 db	16	68
8 db	22	47
12 db	30	27
16 db	36	16
24 db	43	6.2
32 db	47	2.2

. . . K5JKX

Letters

'ear Wayne;

Double saw-bucks being something less plentiful than 5 meter amendments to RM-499, I decided to hold off month and see how you made out. Three hundred venty-eight isn't exactly a landslide, and, despite the ustrious names on our Board of Directors, I was not onvinced that you would make it.

Then came CQ for May, and that editorial! How long is Cliff been pouring his vitriol into Zero Bias? Thinking back, I can't remember an editorial with his characteristic touch.

I am not, per se, a champion for the underdog, although, if there is "reasonable doubt" in each direction, I will tend to favor the persecuted. I consider this a vicious attack, without basis of fact; its only effect, as far as I am concerned, is to cause me to enclose my check for ten dollars, with my best wishes for success in your endeavor.

H. E. Eddy W2SHZ
Oneonta, New York

Dear Wayne:

I received my shiney gold IoAR card today. This puts me in an awful delemma. Shall I flash it to all my friends, and be shunned as an ego-maniac? Or should I keep it buried in my wallets inner recesses, causing the gnawing pain and emotional anguish that those who have rare stamps or tape recordings of talking porpoises must bear. (People just don't understand dept.)

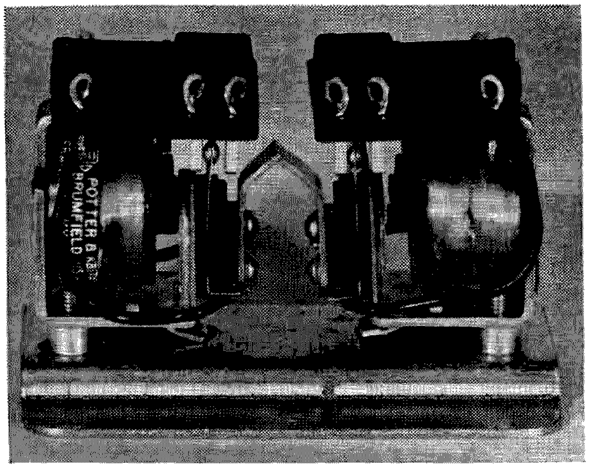
One possible solution might be the forming of local IoAR ham clubs with burly SS men types standing at the doors demanding to see you card as you enter. (This possibly smacks too much of Wagerian festivals at Bayreuth in the latter 30's tho.)

It's a pity that it isn't one of those "badly printed, poorley written, fortunately almost total illegible" types of lithographic art that puts a good feeling in a fellows heart for carefully hiding it in a safe, dark, out-of-the-way place.

I guess this is just a cross that the members must bear. On the other hand, if every ham in the country had one, our problems would be solved!

My profound congratulations and support on your jumping into the Santa Barbara and Denver court battles. This is the kind of action I expected from the IoAR! I'm tickled that it kicked the ARRL into some action.—I don't think it will hurt them a bit to have a standard to aspire to.

Terry F. Staudt, WØWUZ
Loveland, Colorado



Symmetrical latching relay.

Ronald L. Ives
2075 Harvard St.
Palo Alto, Calif.

Controlling Symmetrical Latching Relays

Although they were invented more than 20 years ago, and have been commercially available at reasonable prices for more than a decade, symmetrical latching relays seem to be unknown to a large part of the amateur fraternity, as well as to many industrial electronic engineers.

The symmetrical latching relay consists of two mechanically identical relays, with a mechanical linkage so arranged that when one armature is down, the other rises by spring tension and locks it in place. Henceforth, until the other coil is energized, the armatures retain their relative position. In happy consequence, current is drawn only momentarily,

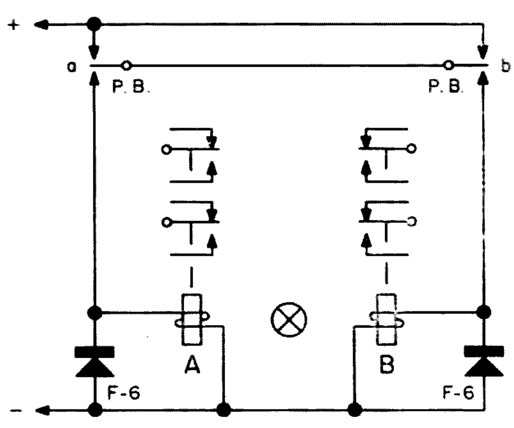


Fig. 1. Push-button control of symmetrical latching relay.

resulting in a great saving in power, and a substantial reduction in heating.

The appearance of a modern symmetrical latching relay is shown, the specific relay shown being a Potter and Brumfield type KB-17-AY, with 115 volt ac coils. Similar relays are produced by a number of other manufacturers; and most of them are available in a variety of voltages, both ac and dc. Standard contact arrangements are 4 and 6 pole, double throw. Most of them have contacts rated at 5 amps resistive.

Because of the mechanical holding feature, these relays are quite insensitive to vibration; and, as the contact interchanges in the two halves are sequent, not simultaneous, these relays can be wired as self-limiters so that they shut themselves off immediately the desired contact transfer has been performed.

Push-Button Control

The simplest controlling method for symmetrical latching relays is by means of twc push-buttons, as in Fig. 1. When button "a' is depressed, coil A is energized, its armaturc is pulled down, and the armature of coil F rises shortly (about 0.1 sec.) thereafter, lock ing armature of A in "down" position. Reverse action takes place when button "b" is de pressed.

The somewhat unconventional push-buttoı connection here shown is to prevent troubl when both push buttons are depressed simul

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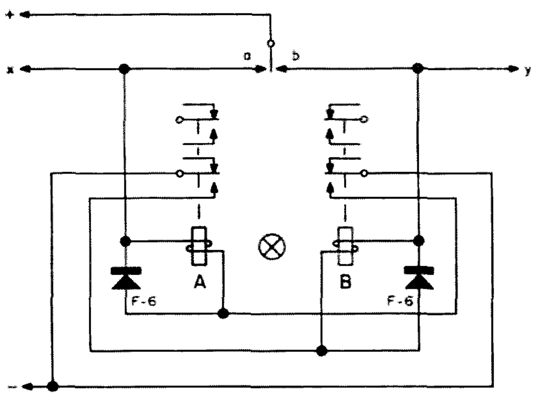


FIGURE 2

Fig. 2. Self-limiting connection.

taneously. As here shown, when this is done, nothing happens.

Circuit shown is for dc operation, the reversed diodes across the coils being spark suppressors. For ac operation, replace them with silicon or selenium "contact protectors" (made by I. T. and T. and Sarkes-Tarzian).

Self-Limiting Connection

For controlling a symmetrical latching relay with a spdt toggle switch, or similar contactor, while limiting current flow to that necessary for relay operation, the self-limiting connection is ideal. One form of this is shown in Fig. 2. A number of alternate circuits, most of them quite obvious, are possible.

In this circuit, let us assume that the switch is in "b" position. Armature of coil B will be down, and locked in place, but coil B will not conduct as its return through the armature contacts controlled by coil A is open.

When the switch is thrown to "a" position, coil A is immediately energized, the armature pulls down, arnd the armature of coil B rises shortly thereafter, locking A armature in down position, and opening the return of coil A, so that it conducts no more current. Subsequent switching to position "b" causes a mirror reversal of this action.

Other loads within its current capacity can be controlled by the switch, a convenient pair of connecting points being x and y (Fig. 2). Note that the self-limiting connection leaves a set of contacts available on each side of the relay (if it is 4pdt). Each set can carry an independent load, but they should not be paralleled to increase current capacity, as they operate sequentially, not simultaneously.

AC operation is entirely practicable here if the diodes are replaced by other suitable flyback absorbers. Be sure that the voltage is reasonably correct (within about 10 percent). In an emergency, ac latching relays can be operated on dc, using either protective series resistors, or an 80 percent reduction in applied voltage.

Single-Pole Switch Operation

Until recently, operation of a latching relay from a single pole single throw switch required an auxiliary relay, which either drew current continuously when the switch was in ON position, or required somewhat costly and complicated auxiliary equipment, such as a capacitative limiter. With the introduction of inexpensive and dependable medium-power audio transistors, the problem is greatly simplified, and current drain in the ON position can now be limited to the hold-off leakage of the transistor plus the bias resistor drain—usually a matter of less than on milliampere per applied volt.

A representative circuit for the operation of a symmetrical latching relay with a single pole single throw control switch is shown in Fig. 3. This is the simplest of a family of circuits derived for the purpose, and also the least expensive to build.

Assuming, for initial condition, that the switch is open, and armature B is down. No current is drawn from the line, as armature A is up.

When the switch is closed, coil A is energized through the armature contacts controlled by coil B; and a strong positive bias is applied to the base of the transistor, cutting it off. Armature of coil A pulls down. Armature of coil B is released, locking A armature in down position, and opening the supply circuit to coil A. When A armature pulls down, the

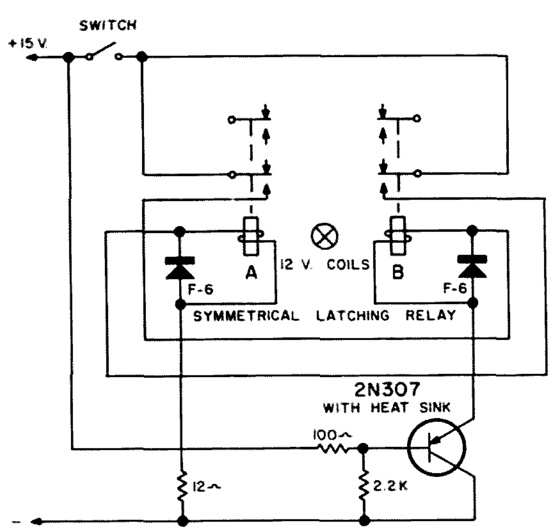


FIGURE 3

Fig. 3. Circuit for single-pole single-thro switch operation of symmetrical latching re lay.

upper end of coil B is connected to supply +, but the coil cannot conduct, as its return through the cut-off transistor is open. Because the transistor responds to energization more than fifteen times as fast as the relay, there can be no ambiguity of action, "schizophrenia," or "buzzering" here. So long as the switch remains closed, armature A remains locked down, coil B is nonconductive, and current drain is that through the transistor base network.

When the switch is opened, cut-off bias is immediately withdrawn from the transistor, and coil B, energized through A armature contacts, immediately conducts. B armature pulls down, A armature releases and locks it in place, and also opens the supply to coil B. No current flows in this position thereafter.

Performance and Service File

Standard symmetrical latching relays, in continuous commercial service, have a service life of several million operations, with only routine maintenance. In ICAS service their expectable life is so great that the relay will almost surely still be good when the equipment in which it is installed has become obsolete.

Needed maintenance is slight, and consists of blowing the dust out periodically, wiping the contacts with a soft cloth about once every six months, and oiling the armature hinges *lightly* from time to time with a good grade of clock oil.

. . . Ives

Letter

My dear Wayne:

Enclosed is a year renewal to 73 Magazine and $10.00 or the IOAR and dont you pocket of the latter ıs per the thot instilled in my dirty little mind by CQ nagazine in the last issue which arrived 2 days before 73 lid. I never before realized what a "scoundrel" you really ıre until I read the Zero Bias page this month. From hat it should be rated at about 5 times cutoff instead of :ero. But I always have been a bit of a non-conformist so or that reason I love a scoundrel such as you are. Keep ıp the good work but be careful and don't get too bitter vith the other side or you could defeat your own ends. So ar you have done a wonderful job.

I enjoyed my fone conversation with you a couple of nonths ago even if during the time I was dropping uarters in the slot you said it was not worth it. You vere not in a position to judge as it was my money.

Clifford van Ciel W6AVZ
Idria, California

IoAR News

(Continued from page 7)

technically upgrade the average amateur. I honestly believe they will feature a spark transmitter with a low-pass filter any issue now —while recommending a new license be required with a grandfather clause to operate this mess.

The sweat, blood and guts of Ross Hull, Grote Reber, Sam Harris, Frank Jones, W2UK/KH6UK, W6NLZ, W9ZHL ,W9WOK, W8KAY, W2AZL and many others—through invention, development and operation of VHF-UHF equipment and communication circuits during the past few years—opened this spectrum of frequencies for all.

Amateurs were actively using frequencies above 300 mc when the NAM thought the magnetron was some new Japanese toy. Amateurs were communicating with each other on VHF when George Southworth was still hiding his waveguide experiments under piles of old telephones to keep from being fired at Bell Labs.

Amateurs can keep their VHF-UHF bands! It is going to take a lot of work and a lot more money.

We have several advantages over our less fortunate dc band brethern. At least for the moment, most UHF-VHF frequencies and the pirates that want them, are under US jurisdiction and policed by the same FCC as you and I.

The amateur must have a voice in every committee and agency that can change the rules and regulations.

Some time ago, a few of us gave up waiting for someone else to start actively promoting amateur radio. We can use your help. The *Institute of Amateur Radio* is a group of the angriest 500 amateurs ever banded together in an all-out effort to expand amateur radio. This expansion can only come in the higher frequencies, and this is why the technicians can do the job. The technicians opened 6 into the band it is today. Before you gentlemen showed everyone how, 6 was deader in the peak of a sun-spot cycle than 10 is now. *You* must open the other bands.

The IoAR is an *action committee* whose prime purpose is to expand the rights, privileges and operating frequencies of all amateurs. As a member, you can contribute an active part in this program. In ARRL, each director tries to represent a whole geographic area of amateurs. In the IoAR, each member represents one or more directors. We have a Washington office. We are actively promoting amateur radio at many levels of agency and committee. We will use brass knuckles, political influence, a well-placed foot on certain individuals' posteriors, or any other quasi-legal action to improve the amateur's image and rights. We have no fancy code of ethics. We *do* have documented evidence of invention, improvisation, development, and prior operation by amateurs on these coveted VHF-UHF bands. We are going to be heard by these various committees or know—and publicize—the reason why we weren't.

The IoAR was formed to see that every person in any position that has influence on the amateurs status is going to be well-informed and aware of the facts, i.e., that amateurs can continue to lead in communication development *only* if given the room and opportunity to expand, and that we have always been able to do many things that were economically unfeasible by commercial or government contract.

With your help, the IoAR will re-establish the amateur's rights in our UHF-VHF bands again. Together, we can get rid of those idiotic sub-band restrictions that keep you from using the low end of 6 and 2. IoAR dues are $10 a year—and we can't even throw in the Old Ladies Journal of Antique Wireless (QST) because every cent goes toward publicizing amateur radio. There are no Chiefs—everyone is an Indian. How well the IoAR does depends on each individual member. A technician can help amateur radio more in the next few months than an ARRL director can in a lifetime. How about helping! The IoAR is not in competition with ARRL. Most of us are ARRL members in good standing—but we won't hold it against you if you aren't. But I'll tell you this. If they continue to act like a home for retired maiden ladies, the IoAR will put rings in their noses and lead them into the cold hard facts of life in a competitive world. I think you are just the guy that can help us.

Bill Ashby K2TKN
Director IoAR
Box 97
Pluckemin, N. J.

Institute Report

The Interim Directors of the Institute of Amateur Radio hafe been preparing by-laws of the Institute for submission to the members, a process which has been taking a great deal of their time

The Directors accepted the resignation of Bil Leonard W2SKE as an Interim Director. Leonarc had been inactive in Institute affairs.

(Turn to page 73)

E. M. Schaod W9AIY
2048 South Meridian Street
Indianapolis, Indiana

ARRL's Motives: A Closer Look

Now that they're "official," the current re-exam proposals of the American Radio Relay League can be read loud and clear—and their message is one of discrimination, undesirable change in government policies and protection of "The Old Guard."

ARRL has petitioned the Federal Communications Commission to remove all General and Conditional Class licensees from the choice High Frequency (HF) radio-telephone bands, pending a re-examination of operators in these classes.

In the past several months ARRL's position has vaccilated, indicating that frustration may have been running rampant within the League. But modified versions of rash license proposals by League directors have now been supported by ARRL's "front office," and the petition has been introduced to FCC (see November *QST*). ARRL proposes the loss to General and Conditional operators of the 20-meter phone band beginning July of 1965, the 40- and 15-meter phone bands beginning July of 1966 and the 75-meter phone band beginning July of 1967.

This across-the-board cut is far more radical than a more commonly accepted method of reducing QRM: attrition licensing, whereby initial licensing requirements may be elevated. Apparently no one in ARRL has considered this accepted and time-tested method in view of the League's panic to drastically decimate HF phone band participation.

The League's *stated* purpose is to "provide additional self-training goals and thus to strengthen the position of the amateur radio service in both domestic and international affairs. ARRL would reinstate the Advanced Class licensing category. Those already holding Advanced Class licenses (old Class A) would continue to operate on the HF phone bands without interruption.

The laudable *stated* purpose contrasts markedly with ARRL's purposes in the past, as shown by a few examples from recent radio regulatory history.

In 1949 the League opposed the FCC's attempt to commit amateur radio operators to a "basis and purpose," as witness the frantic editorial "It Seems to Us" in QST, June 1949. The ARRL was jolted when it discovered that the FCC had a mind to formulate on its own—Docket No. 9295, April 1949—a reorganization of amateur service in the U.S. with a newly-added "Part 12.0, Basis & Purpose."

We quote from the editorial the ARRL's expressed feelings toward the new governing principles: "We have such new things as an initial declaration of purposes for the amateur service; the introduction of what may be termed apparatus specifications in our regulations (which the League has always opposed in principle)." This attitude seems to contrast strangely with current *great concern* of the ARRL over "international considerations."

ARRL fought in 1949 for a "grandfather clause" for old-timers. The League felt that the so called grandfathers should have more operating privileges, mainly due to longevity more than anything else. The proposal was shot down by FCC. It now appears that ARRL has a long memory.

The 1963 proposal looks like the same old "grandfather clause" suggestion under a diff-

erent guise.

There is no known proposals by the ARRL for re-examination of the small remaining class of amateur radio operators who will be permitted to continue on the best HF phone bands. Ironically, the lack of proposals concerning this "elite" reflects a conflict with the stated intent of the ARRL program:

> " . . . Should not sit idly by and risk the loss of our frequencies," and "should join together in a common effort to preserve and improve amateur radio."

Should the many—General and Conditional Class operatiors—"join together in a common effort" to preserve the bands for a few—the Amateur Extra and Advanced Class Operator?

Nor has it been proven that General and Conditional operators abuse the bands any more or any less than do Advanced and Amateur Extra Class operators.

Today a vast number of radio amateurs are in the General and Conditional classes, set up by FCC (not at the suggestion of ARRL) in 1949. This large body of radio amateurs would suffer greatly by the ARRL's proposed preferential treatment for Amateur Extra and Advanced classes. The segregation of the General and Conditional classes from HF phone privileges, if consummated, would be one of the boldest discriminatory actions of recent years.

Perhaps 9% or so of the General and Conditional class operators would immediately return to all the HF phone bands after promulgation of ARRL-proposed regulations. What about the other 91%? They will be faced, first of all, with an "accelerated depreciation" of their popular "name-brand" radio-telephone transmitters while attempting to requalify themselves. Perhaps coincidentally, they will be "scrambling" to buy future editions of the ARRL license manuals in order to bone-up for their re-examination.

Some may discover difficulty in their attempt to recover the once-obtained phone operating privileges. Some will not be able to wallow their bitter personal feelings and animosities and will not attempt to participate again in amateur radio.

The ARRL petition ignores the current commendable efforts of the FCC to upgrade gradually the technical portions of examinations in Novice, Technician, Conditional and General classes. Doesn't FCC get any credit for this program?

No sensible radio amateur is against any reasonable approach leading to the improvement of on-the-air operating techniques, nor

does he oppose any reasonable attempt to preserve the world-wide amateur radio frequency segments. But the current proposals of the ARRL are unreasonable. They contrast distinctly with the intelligent and conservative approach that has won admiration for ARRL in the past.

ARRL blames "development and availability of highly complex and efficient manufactured equipment, particularly single sideband suppressed carrier radio-telephone transmitters, receivers and transceivers" for raising a question as to whether amateur radio's "basis and purpose" are being fulfilled.*

Today we are operating amateur radio channels within a highly technological and complex electronics environment. We can never hope to recapture the colorful era of "ham radio" and its BCI prior to the last great war. That's history!

ARRL is further concerned that General and Conditional operators cannot build or repair this equipment for the most part and that these HAMS "lack an understanding" of it. The League claims there has been little incentive for many amateurs, once licensed, to increase their technical knowledge and proficiency.

(EDITOR'S NOTE: Remember, they opposed the original statement of "basis and purpose.")

So they propose to give these classes more incentive by forcing them to participate in the available CW portions and the unpopular (because of the sun spot cycle) 10-meter phone band?

Obviously ARRL thought some incentive existed earlier. Their publication of help-along license manuals and many successive editions updating the technical portions that characterize the timely upgrading of the FCC examinations, including those of the General Class license, were recognized to be extremely valuable. The manuals were particularly appealing to the non-technical strata, that is, many of the same group of general types that the ARRL now seeks to eliminate from the phone bands. These helpful manuals provided a "gateway to amateur radio" for the herd that was to be raised through the ranks from the Novice and other classes.

The ARRL courted membership by invitational advertising, through the stimulative booster campaigns at affiliated club levels, through publication of the enhancing "Basics for Beginners" and many other fine articles.

Among these attractions are the delectable displays of colorful advertisements—selling the very same items of equipment to which the League now so strenuously objects.

ARRL's petition—speaking of commercial factors—would have serious domestic economic implications. Sales of new equipment will without doubt decline noticeably. Used equipment markets will feel an even more drastic pinch. FCC, in its evaluation of public policy, is faced with consideration of the economic factors.

The League role as representative of amateur radio operators should be examined in connection with the current petition. ARRL claims membership of "more than 80,000 amateurs licensed by the Commission." FCC licenses 250,000 amateurs currently.

ARRL would be hard-pressed to pretend to that all their membership supports the petition. This leaves a fraction of the 250,000 as supporters of the ARRL proposal.

On the other side of the representation coin, who speaks for amateur radio operators in international negotiations? A number of recent *QST* articles have referred to the performance of ARRL officers as "members of the official delegations to the actual conference sessions," of Internatinational Telecommunications Union conventions. On close scrutiny it appears, however, that ARRL participates more in the capacity of a "private operating agency" in support of the real representative of the U.S. amateur radio operators: *FCC*

This is not to ridicule ARRL's gallant actions (assisting the FCC) to preserve the amateur bands. It is merely to appreciate ARRL's tendency to overstate their role.

Regarding these international considerations—on the basis of ARRL's position—the FCC appears to be somewhat nearer to the amateur operator at home and abroad. This federal agency, with its official monitoring role, would appear to be closer to the actual problems than ARRL, with the latter's representative structure and minority membership status.

In addition, there is unlikely to be any measurable effect upon the retention of international amateur bands by heavy QRM or by some yokel's insistence on repeating "73's" (best regardses) for the thirteenth time. The real threat to international amateur bands is far above this level and stems from tariff and international political considerations. As long as the U.S. is the strongest nation politically and economically, and as long as the U.S. supports its own HAMS, it is unlikely that the "threatened" international bands will be usurped. (For the experts: Yes, we know there have been two plenipotentiaries and only one U.S. vote.)

The U.S. has every reason to support its amateur radio operators. In addition to the FCC's proven (as witness 1949) support for enlarging amateur radio, an ardent benefactor has been the entourage of the Department of Defense's military and civilian technical advisors. This Pentagon entourage attend—on behalf of respective departments, Army, Navy and Air Force—the International Telecommunications Conventions as members of the government delegations.

The Department of Defense supports amateur radio for reasons of its own. In a national emergency, amateur bands could be vacated with the least practical delay. Amateurs have demonstrated their availability for future mobilization of manpower for national emergency.

Amateur operators who agree or, hopefully, disagree, with the ARRL petition can still have a voice in any policy decision that is made by the FCC. Here is how:

(1) Watch for 73 Magazine for the publication of FCC's "Notice of Proposed Rule Making." Note the Docket Number.

(2) Prepare a brief, concise rebuttal covering your major objections and/or recommendations. Refer directly to the FCC's "Notice of Proposed Rule Making" by the indicated Docket Number (if a rule if formulated).

(3) Limit your rebuttal to no more than two double-spaced typewritten pages. Present in fourteen (14) typewritten copies (this is standard FCC procedure). Carbon copies will do if they are easy to read.

(4) Mail to the Federal Communications Commission, ATTENTION: Chief, Amateur and Citizen Radio Division, Washington 25, D.C.

Watch for the notice and make your objections. There's no excuse for griping on the *remaining* General Class phone bands.

. . . W9AIY

Letter

Dear Wayne,

First I wish to say that 73 Magazine certainly fills the bill as a truly "ham" magazine. It's articles are written in a most refreshing manner, while at the same time its editor is man enough to be frank, outright, and above all, honest in his beliefs. Wayne, could you please inform me as to what in blue blazes Herbert and John are trying to do to the spirit and morale of the members of the A.R.R.L.? I've had my ticket about two years, and in that time became a member of A.R.R.L. for a one year period and dropped from its ranks for another year. After due consideration I thought, "Oh well, maybe I'm the one who is wrong, perhaps I should breakdown and rejoin the 'happy folk' up at Newington." Rejoin I did. Regret I do. The June 64 issue of QST carries an article by William Orr, W6SAI which if not the most insulting thing ever directed to the general ranks of amateur operators certainly deserves credit for using a lot of words to confuse an issue.

William tries to say in so many words that a vote on RM-499 is not called for. I guess that would be cricket in their book. William goes on to say that the letters written in opposition show poor spelling of words, and a poor show of the "radio amateur's attempt to communicate by writing." Thank you William, thank you A.R.R.L. With friends like you the amateur body needs no enemy. To further justify their bumblings he points out that there are "two breeds of cats" in amateur radio. The first are those who, through the blessing of the "Great White Father" (A.R.R.L.), are at once placed ahead of the others because they held their license for a period of 10 years or more. The not so desirable type who really isn't an amateur (again according to William) are those who have been licensed in the past decade. (But William, I thought the A.R.R.L. was "by and for the amateur" ! ! !) Again a sugar-coated pill is forced upon by us by the statement that RM-499 will better amateur radio as a public service. My, my, William, tell all of the operators in the recent earthquake in Alaska that they really are below par in capabilities. (Of course, while going about their duties they were so busy you will have to excuse their ignorance in these matters that only the Boys in Connecticut know about.) Let us face one fact and that is: if enough nations vote for a slash in amateur band coverage no matter how well educated in radio theory we be, the slash will come. Another thing: if we read our governments' rules and regulations it is they who set most of the requirements to become an amateur. If the government itself sets standards what can be the reasoning of a group of individuals who try to set up their own? (What say William?)

Wayne, I guess I've gone a bit far out but at least I feel that my words do not fall on deaf ears. Here is a promise that I am making in earnest, that in a very short time I will be numbered among the members of the IoAR

Mike Francioli WB2BQ(

(Institute Report from page 66)

Founding members now should all hafe received the special Founding Member gold certificate, the special laminated gold membership card, a supply of Founding Member stickers for their QSL's, two status reports on current activities of the Institute, two official information reports to be broadcast and background information on the reasons for the Institute.

The Interim Directors are looking for help in setting up the Institute organizaion and ask that you drop a line to the Institute of Amateur Radio, 5219 7th Road, South Arlington, Virginia if you have some time to help with this.

The Institute now has five men working in Washington toward establishing a lobby for ham radio. A founding Membership in the Institute is $10. Send your name, call, address and $10 to the Institute of Amateur Radio, Peterborough, N. H.

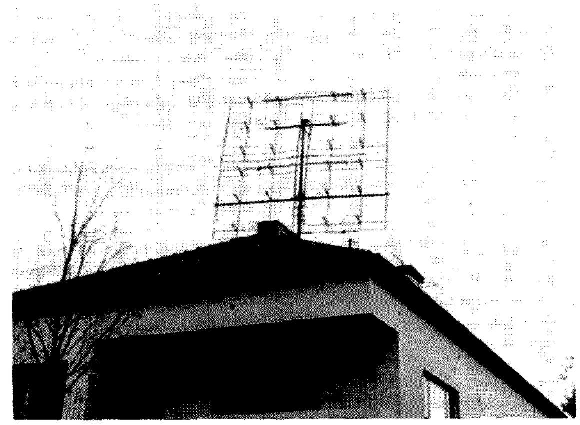
Working New Countries on Two Meters

The European Side

After many years of intensive experiments, ˌenna Suominen OH1NL and Bill Conkel V6DNG finally succeeded to make the first- ver moon-bounce contact both ways on 144 nc.

When they started the experiments a couple f years ago, the specialists considered it as a seless waste of time and impossible to do. n a meeting of well-known European VHF- ıen the fact that moon-bounce contact on 44 mc would be impossible, was proved by water-proof" mathematics. The factors were ıe present amateur technics and the maximum owers allowed for amateur use; these were onsidered too inadequate.

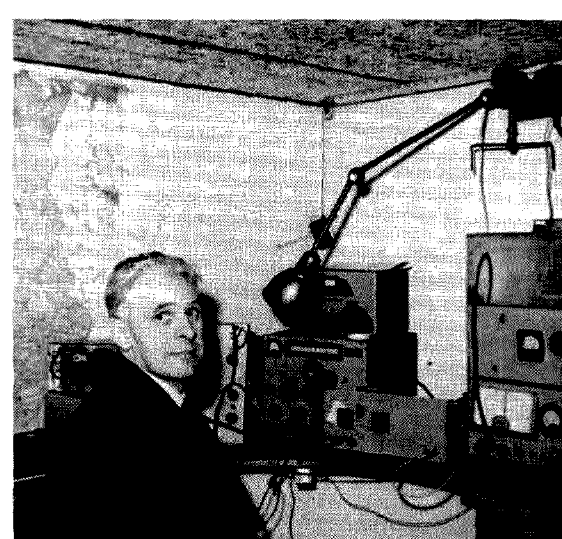
However, Bill and Lenna started where the hers had stopped. They concentrated them- elves in the signal-to-noise ratio. I.e., they ent "below the surface." The positive tests ıring several months proved that they are ı the right track, and finally, on April 11th,



1964 they made it two-way. Earlier both of them had heard signals from each other, but not in the way that they could have been also confirmed both ways. On April 11th this was possible, and a duly two-way contact was written in 144 mc history. This contact is the first moon-bounce contact on 144 mc, and also represents new world record on two meters.

The work behind the final QSO was tremendous. Two years, and over 70 experiments plus innumerable amount of working hours for building the equipment. Dr. Karl Lickfeldt, DL3FM, the chairman of the IARU Region I VHF Committee, in his letter of congratulations to OH1NL said: "Only few radio amateurs will understand what you have done, but I understand—while realizing the happening—that you have really nicely done what some others have been trying hard on 1296 mc." (To clear this, the moon-bounce on 1296 mc is considered easier than that on 2 meters.)

W6DNG used 1 kw power, rebuilt 75A4, converter input 416B and antenna stacked, several-elements yagi-system. OH1NL used a



OH1NL

power input of 800 watts (special permission from the Finnish authorities) and 24-elements stacked, net-reflector antenna and home-built nuvistorized receiver. This contact reminded especially the old timers of the contact which S-2ND and PR-YSA in 1925, on August 29th, made on 43 meters as the first Finland-USA contact. The pioneering work still is in the mands of amateurs, only the technics and bands have changed.

The OH1NL-W6DNG moon-bounce QSO was made on April 11th 1964 between 1500-1600 GMT. OH1NL is located in a village named Nakkila, approximately 20 miles southwest from the city of Pori on the west coast of Finland. The experiment, which finally succeeded, was the 73rd. Before this Bill W6DNG had changed his antenna many times, the "record" antenna being 59th during these tests. OH1NL used a 24-element 21 db antenna (12 dipoles parallel-coupled) with a net reflector, the area of which is approximately 25 square meters (over 250 sq. ft.), with bazooka-feeding and preamplifier. This antenna can be both tilted and rotated both ways. The best time for the contact was to be found from the "Nautical Calendar" giving the positions of the moon. The equipment itself used by OH1NL is very typical amateur equipment as to the look of them. The shack merely is VERY amateur-like when you visit it. But this shows that the results are not made by fine looks, they are made by means of high skill and experience. Nothing seems to be impossible for radio amateurs, even though things often are proved impossible by means of theory before the results show otherwise.

Hats off to Lenna and Bill!!

The American Side

Bill Conkel W6DNG
4608 La Cara
Long Beach, California 90815

A few years ago the Army bounced a signal back from the Moon. Then the Collins company bounced a signal back. This got me interested enough to start working on the project. The success of W4AO and W3GKP in 1956 spurred me on.

I started out with a kilowatt input (about 600 watts out) into four ten element yagis horizontally polarized. The receiver was a 7A converter into a 75A2 with a very nar-

row filter. I did get some echos back from the moon on the eastern horizon, but I couldn't seem to find anyone else to bounce to. Most fellows thought I was nuts . . . so I got back an echo, big deal!

Ned Conklin K1HMU got interested in moonbounce and set up quite a station. We kept skeds through the summer of 1961 and had several close calls. On September 14th we almost made it. This was a real heart-breaker. We got all but one piece of the info across that ARRL requires before you can officially say that you've made contact. By the next summer Ned had an even bigger antenna going and our regular contacts were frequently nearly acceptable for credit . . . but never complete.

It was about this time that OH1NL and I began to correspond and set up skeds. We tried it from two to twelve nights or days a month . . . sometimes getting nothing and sometimes exchanging signals which almost added up to a QSO.

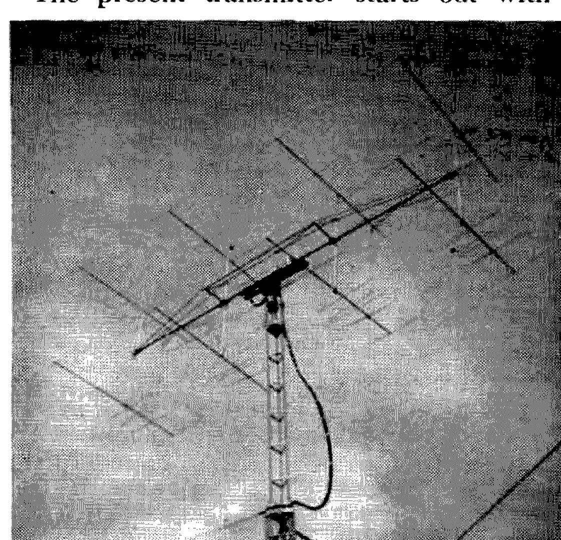
All this time I had been gradually improving my equipment and bringing it up to the best possible. Until last December all three of us had been using circular polarization. I got the bug to try horizontal again since I could build a much higher gain antenna this way and it would have less wind resistance. I wrote to Lenna OH1NL and he agreed to change over to horizontal. Circular polarization would seem to have benefits for moonbounce, but the added weight and wind resistance are against it . . . as well as the fact that horizontal is better for meteor scatter work and for general contacts with other stations.

On April 11th this year Lenna and I did make a valid two meter earth-moon-earth QSO.

I suppose that the futility of trying to work any distance on two meters from the Los Angeles basin (mountains all around except for ocean) may have had something to do with my looking to the moon for some DX. There is just no way to work long distances from here except by moon or meteor scatter.

Apparently everyone but me knew that there was no way to beat that 251 db attenuation in the earth-moon-earth path using amateur equipment. That's kind of like the bumble bee not being able to fly because it is aerodynamically incorrect. Antenna #59 (my 59th two meter antenna since 1952) consisted of eight seven element short yagis, two high and four wide, with 300 open wire phasing lines. The feed line is RG-17A/U. It has been aimed optically since the automatic system quit in 1962.

The present transmitter starts out with a



highly stabilized 8 mc oscillator which hasn't turned off for over two years. It doesn't drift. A 5894 buffer drives the PP GG 4X250B's. The receiver starts out with a 416B preamplifier into a nuvistor converter into a 75A4 using a 500 cycle filter and an 80 cycle audio filter. I've got a feedback circuit for noise cancelling built in, but that's another story.

This is a lot of trouble to go to just to work a new country, I'll admit. However, if you get the bug to give it a try remember that your major effort should be in the antenna. Don't pay too much attention to advertised gain figures on yagis. I've tried and tried and I've yet to see a yagi of any length that measures over 13 db gain and some of the stacking that goes on adds a few db at times, and loses 'em in others. Circular antennas are very difficult to stack and the gain is hard to measure in either plane. All in all I don't recommend that you rush out and buy a bunch of antennas unless you can measure their gain as you set them up and tune them.

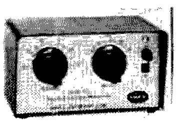
The receiver must get right down to Johnson noise and have AFC or some kind of phase lock because you can't tune around for signals that are this weak. You have to know the frequency the other fellow is on and hope that doppler shift and other influences don't take the signal out of the notch.

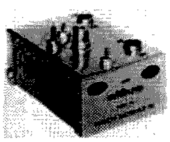
Let me know when you're fired up and ready for a try . . . OK? . . . W6DNG

VHF Buyer's Guide

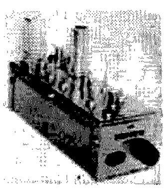
AMECO

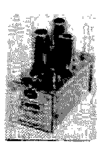
American Electronics Company
178 Herricks Road
Mineola, New York



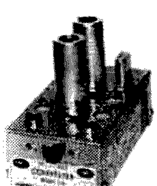


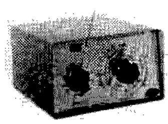
Preamplifier Model PCL (left) for all bands 80-6 meters. Nuvistors give 20 db gain. Nuvistor preamplifier for 50, 144 or 220 mc (right) Model PV. Both require power from receiver or from PS-1 power supply. PV . . . $13.95. PCL . . . $24.95.



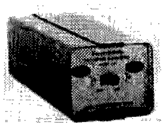


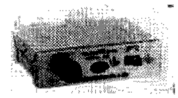
Converter (left) for one band 50-144-220 mc, two nuvistors, one 6J6. Any i-f output. No power built in. PS-1 power supply separate unit. Converters (right) for 6 or 2. Use tubes. 6ES8-6U8A-6J6. Output 7-11 mc or 14-18 mc. CN . . $44.95. CN Kit $31.95. PS-1 . . $11.50. PS-1 Kit $10.50. CB6 . . $27.50. CB6 Kit . . $19.95. CB2 . . $33.95. CB2 Kit . . $23.95. CSB . . $9.95 CSB Selector box.



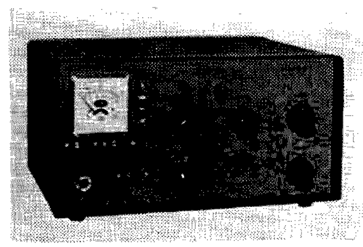


Model CLB (left) 6 meter mobile converter, 12 volts dc power. Model CMA (right), all band converter, 1700 kc-54 mc and 108-174 mc. 3¼" x 6" x 6¾". Requires crystal ($3.50). Uses internal battery. Transistorized. PS-2 power supply provides 12 vdc for CLB from 115 vac. CLB . . $24.95. CMA . . $64.95. PS-2 . . $8.50.





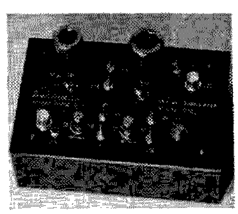
Model CHT, transistorized, built in battery or car battery through BS-9 adapter. CHT converts 2 meters to broadcast band. Can cover from 108-174 mc. Mode lCLT same as CHT except converts any ham band from 2-54 mc down to the broadcast band or any other i-f output. Model SNL squelch & noice limiter, 6 or 12 vdc. SNLT all transistor. CLT or CHT . . $35.95. BS19 . . $2.95. SNL . . $17.75. SNLT . . $19.95

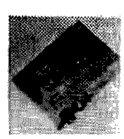


TX-62 6 and 2 meter bandswitching transmitter. 75 input on AM and CW, with built in modulator and solid state power supply. Broadband circuits except in final. Uses 8 mc crystals or external VFO. 11½" x 9½" x 6". $149.95.

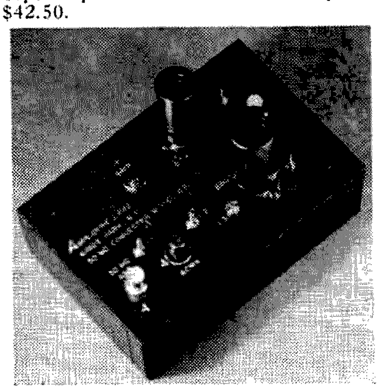
Amplidyne Labs

Amplidyne Laboratories
Box 673
Kings Park, L. I., N. Y.

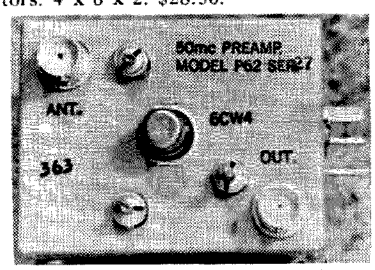




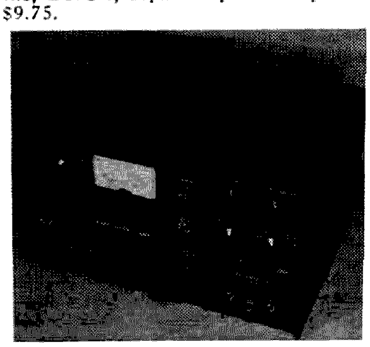
C-23 two meter nuvistor converter. Two 6CW4's in grounded grid rf amplifier, 6J6 crystal oscillator, 6BQ7 mixer-*if* amplifier. Requires separate power supply or voltage from receiver. Output 14-18 mc. Special outputs $1 extra. BNC connectors. 4" x 6" x 2". $34.25. PS-4 Matching power supply $9.75 (right). C-14 1¼ meter nuvistor converter. Identical to the C-23 except input 220-225 mc and price $42.50.



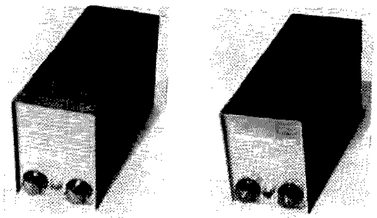
C-61 six meter nuvistor converter. One 6CW4 grounded grid rf amplifier, 6BQ7 mixer and oscillator, 6C4 *if* amplifier. PS-4 matching supply. 14-18 mc output. BNC connectors. 4 x 6 x 2. $28.50.



P-62 Nuvistor preamplifier, 50-54 mc BNC connectors, separate power supply required. $9.75.
P-25 nuvistor preamplifier, 144-148 mc, BNC's, separate power required $9.75.



Model 621 six and two meter transmitter. 60 watts to GE 8150, 6L6's plate mod. Xtals or external VFO. Built in dummy load, separate loading controls, spotting button, metering of all stages including rf output using external meter (not supplied). $229.50.

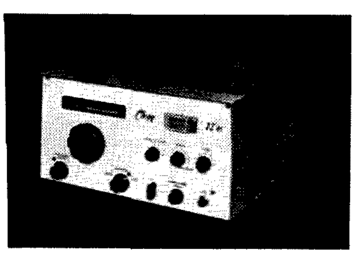


126 nuvistor three band converter, 6-2-1¼ meters, built in power supply, 2-6CW4's, 6DJ8, 6J6. BNC connectors, four *if* outputs (7, 14, 26, 30.5 mc) available. $94.50.
Model 221 (right) is an adapter for the 621 transmitter and puts 18 watts on 220 mc. 6360 output. Uses 55 mc output, power supply, modulator and metering of 621. $72.50.

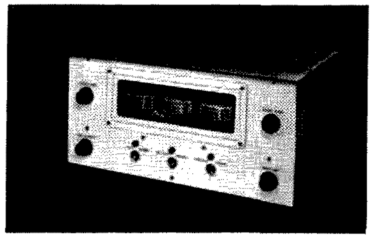
Iodel 221 220 mc adapter for the iodel 621 transmitter, which supplies modulation, power and 55 mc rive. 15w AM input, 18 watts CW › a 6360. 4 x 5 x 10. $72.50.

Clegg

ʇuires-Sanders, Inc.
'5 Watchung Avenue
'atchung, N. J.



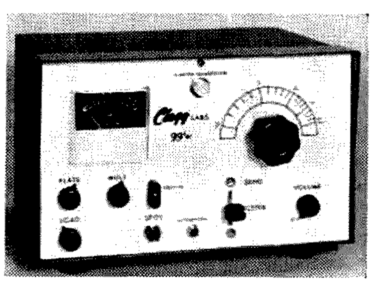
:gg 22'er two meter transceiver. ıal conversion receiver with crys- lattice filter, Nuvistor RF stage, effective noise limiter. Transmitter ; broadband exciter stages, 18 tt high level modulated 2E26 final, sh to talk and provisions to switch ernal final and VFO. Built in id state power supply for 115 vac l 12 vdc. $239.50.



Clegg Apollo 700 six meter linear amplifier. 700 watts PEP with 10 watts of drive. Push pull 8236's. Automatic control with Venus transceiver. Three meters. Built in solid state power supply. 15 x 7 x 10½.

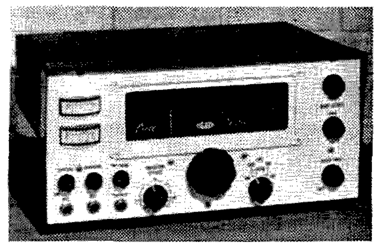
Clegg Model 372 Lo-Pass filter. 50 ohm impedence. Less than, .5db insertion loss to 50.7 mc. More than 28 db attenuation at 55 mc, over 40 db on any TV channel over 68 mc. Am power rating with VSWR of less than 2:1, 120 watts below 51 mc, 240 watts below 30 mc. Adjustable notch tunable from 55 to 68 mc.

Clegg Interceptor B six and two meter receiver. Tunes 50-54 mc with built in converter for 144-148 mc. Flywheel dial, entire dial tunes one mc at a time. Nuvistor rf stages. Crystal lattice filter for selectivity. Designed for low cross-talk. 15" w, 9" h, 9" d. 32 lbs. $473. Allbander converter for 3-22 & 27-31 mc.

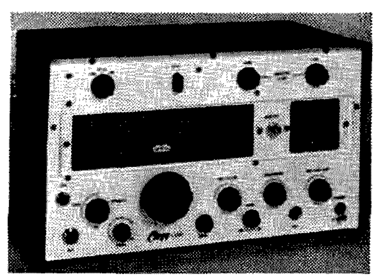


Clegg 99'er six meter transceiver. Double conversion receiver, S-meter, spotting switch. Transmitter crystal controlled (or external VFO), 8 watts to 7558 final, plate modulated. Receiver covers 50-52 mc for good bandspread. AC power supply built in. S-meter switches for transmitter tuning. 10" w, 6" h, 8" d. 14 lbs. $179.95.

Clegg Thor, six meter transceiver. Receiver has crystal lattice filter for selectivity, BFO, tunes 50-52 mc, external speaker (not supplied). Designed for low cross modulation, images, *if* leakthrough. Transmitter is VFO in receiver frequency or crystal controlled. 60 watts on AM or CW to a 6883 final. Separate (but included) power supply and modulator uses two 6CU6's in Class B. S-meter switches for transmitter tuning automatically. Variable BFO injection for SSB detection and spotting. ANL. 12" w, 6" h, 8½" d. 15 lbs. Power unit 12" w, 6½" h, 8½" d. 27 lbs. $349.95. 12 vdc transistorized supply $119.95.



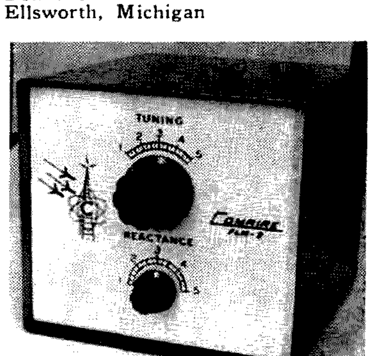
Clegg Venus VI, SSB transceiver for six meters. Receiver tunes 50-50.5 mc (or any other 500 kc band if specified), crystal lattice filter for selectivity, nuvistor front end. Transmitter 85 watts AM, SSB, CW to 6883 final. Tuning dial: 1 kc per division. Receiver may be offset from transmitter frequency by plus or minus 1 kc. Requires separate power supply. $495. AC power supply $110, 12 vdc supply $120.



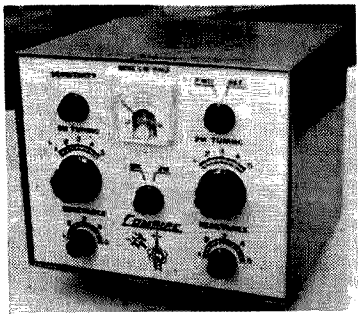
Clegg Zeus six and two meter transmitter. 185 watts AM or CW on both bands to a 7034. 811A's class B plate modulation, 18 db speech clipping with automatic modulation control. Crystal oscillator or built in ultra-stable VFO. Flywheel tuning dial. Power supply and modulator in separate unit with interconnecting cable. $695.

Comaire

Comaire Electronics
Box 126
Ellsworth, Michigan



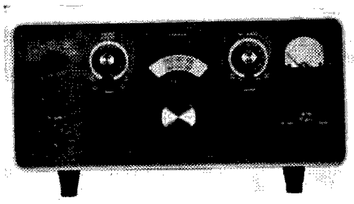
FLM-2 two meter line matching unit to match transmitter to feedline. **FLM-6,** same thing only for **six** meters. $19.95.



LM-6N2 Line matcher. Combination six and two meter antenna tuner with built in SWR power meter. 500 watts. 7½" x 6" x 7". 8 lbs. Tuners are completely separate. $59.75.

Collins

Collins Radio Co.
Cedar Rapids, Iowa



The 62S-1 converts a 14 mc AM, CW, SSB, or RTTY signal to 6 or 2 meters. N.F. 4 db and power input 160 watts. High voltage is taken from the present exciter. Size: 7¾ h, 14¾ w, 13 d. Weight: 25 lbs. Price: $895.00.

Electronics Specialists

Electronic Specialists Laboratories
301 South Ayer Street
Harvard, Illinois

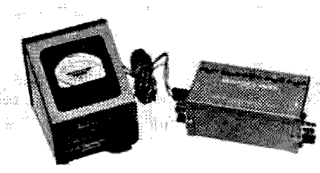
The ESL nuvistor pre-amp is available in models for 50-54, 144-160, and 220-225 mc. Size: 2 w, 1⅝ h, 1⅝ d. Price: wired $8.95, kit $5.95. All nuvistor converters $56.95 with power supply, $44.95 without.

Fulton

Fulton Electronics
Manteca, California
Two meter transmitter for use with crystal mike. Two watts output, complete with modulator and three tubes. $25.00. Six meter transmitter. Similar to above, four watts output. $25.00. Two and six meter super-regen receivers with audio stages. Two or six meter transceiver with AC power supply. $78.00.

Gavin

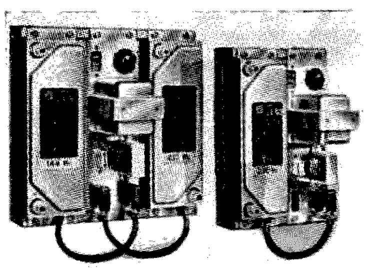
Gavin Instruments
Depot Square and Division Streets
Sommerville, N. J.
BP-144 tunable band-pass filter for 2 meters. Pass band 2 mc., rejection 35 db 5 mc from center frequency (adjustable from 144 to 148 mc), insertion loss less than 1 db., power 190 w plate input. 52 ohms, UHF connectors, 4 x 2¼ x 2¼. $11.85.



The Maverick is a 5 section tunable 6 meter filter with rejection of unwanted signals greater than 35 db., insertion loss less than 1 db. 400 watts plate input. 50 ohms impedance, UHF connectors 5 x 3 x 2. $16.95. Maverick II has identical rf circuitry but includes power measuring meter in 2 ranges, 0-50w and 0-400w. $34.95.

GELOSO

American Geloso Electronics
251 Park Avenue South
New York 10, N. Y.



Model 4/160 6 meter nuvistor converter. 3 db noise figure, 4 mc band pass, 70 db image rejection. *If* 26-30 mc. $109.95.

Model 4/161 2 meter nuvistor converter. 3 db noise figure. Similar to 4/160. *If* 26-30 mc. $109.95.

Model 4/162 220 mc nuvistor converter. 5 db noise figure. Similar to 4/160. $109.95.

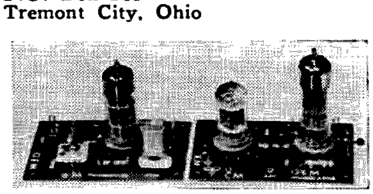
Model 4/163 432 mc nuvistor converter. 5-6 db noise figure. Similar to 4/160. $139.95.

Power supply for above converters. 4/159. 110-220 v, 50-60 c. $29.95.

4/103 Geloso 2 meter VFO. Drives 832 or 2E26. $29.95.

Gem

Gem Electronics
P.O. Box 203
Tremont City, Ohio



6 meter transmitter-exciter. 5 watts. Uses 8 mc xtals. 1 6AU8. 2½ x 4. $6.50 less tube. XT.

Modulator for above. 1 12AX7 and 1 6AQ5. Carbon or xtal mike $5.00 less tubes. MA.

Cascode nuvistor pre-amp, uses 2 6CW4. 20 db gain. 6 meter and 2 meter. 2½ x 2. PA-C. $4.50 less tubes.

2 meter nuvistor preamp. Up to 30 db gain. Uses 1 6CW4. 2PA. $4.00 less tube.

6 meter nuvistor convertor. Uses 4 6CW4. *If* BC to 14 mc. 2½ x 4. $7.50 less tubes and xtal. 6MC-N.

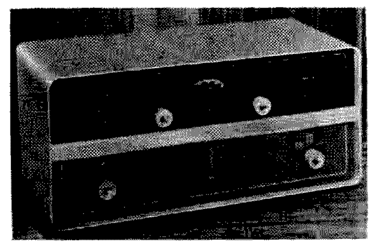
2 meter nuvistor convertor. Uses 4 6CW4. *If* 6 to 14 mc. 2½ x 4. $7.50 less tubes and xtal. 2MC-N.

2 meter convertor. 1 6CW4 and 1 6U8. *if* 6 to 50 mc. 2½ x 4. $7.50 less tubes and xtals. 2MC-X.

2 meter super-regen receiver. 6CW4 and 6U8. 2½ x 4. $6.50 less tubes. 2-SR.

Hallicrafters

Hallicrafters
Chicago 24, Illinois



HA-2 and HA-6 transverters. Converts ten meter transmitters and receivers to six or two meters. 5894 final for 120 watts input, can be driven by any 10M exciter from 10-100 watts. Requires separate (P-26) power supply. 8"H, 17"W, 9"D. $349.50.

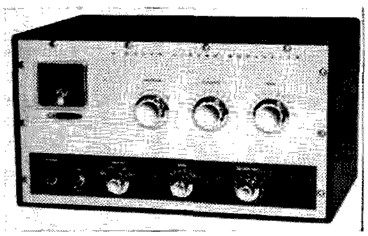
Heath

Heath Company
Benton Harbor, Michigan

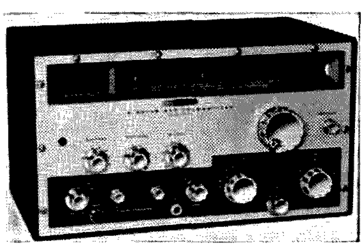
The VHF-1 Seneca is a 6 and meter transmitter kit with 140 wat CW and 120 watt AM input t 2-6146's. VFO, 4 crystal socket carrier control modulation, band switching, power supplies include Size: 10⅛ h, 16⅝ w, 10 d. Weight 50 lbs. Price: $179.95.

The HW-10 and HW-20 are 6 and 2 meter transceiver kits, respectively. 6 meter Shawnee covers 49.8-54 mc, 2 meter Pawnee 143.3-148.2 mc. Both feature built-in supply for 6, *12* or *120* volts. *10* watt *6360* final, push-to-talk microphone, VFO or crystals, internal speaker, 15 kc selectivity, double conversion, squelch, BFO, AVC. Size: 6 h, 12 w, 10 d. Weight: 34 lbs. Price: $199.95.

The HW-29A and HW-30, the Sixer and Twoer, are 6 and 2 meter transceiver kits. Crystal controlled transmitters, 5 watts input to a 6CL6, tunable superregenerative receiver, with microphone, less crystal and mobile power supply, built-in ac supply. Weight: 8 lbs. Price: $44.95, GP-11 mobile power supply kit $16.88.



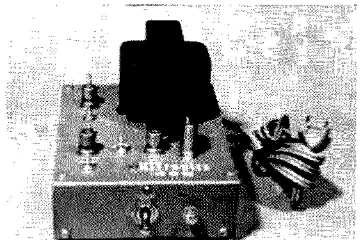
The HA-20 is a 6 meter linear amplifier kit to match the HX-30. 2.5-10 watts drive, 125 watts PEP SSB, 75 watts AM, push-pull 6146's, forced air cooling, self-contained power supply. Size: 10⅛ h, 16⅝ w, 10 d. Weight: 43 lbs. Price: $99.95.



'he HX-30 is a 6 meter SSB transitter kit with 20 watts input on ;SB, AM and CW. Phasing SSB, 'OX, anti-trip, VFO, grid block eying. Size: 10⅛ h, 16⅝ w, 10 d Veight: 50 lbs. Price: $189.95.

HiTronics

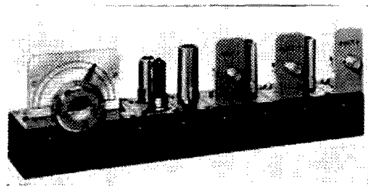
[iTronics Inc.
716 Evanston
'ansas City 33, Mo.



6CN Converter for 6 meters. 3 nuvistors, 2.5 db noise figure, built in low pass filter. Built in power supply. Standard *if* 28-32 mc, others available on order. 4 x 5¼ x 4. Price *$35.00.*

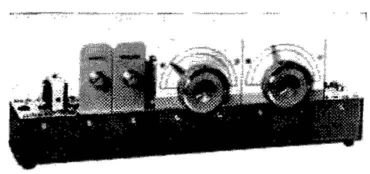
International Crystal

**International Crystal Manufacturing Company, Inc.
18 North Lee
Oklahoma City, Okla.**



AOF VFO kit. 8-9 mc VFO for six and two meter transmitters. ½ watt output. AOF-89 includes VFO and buffer $22. AOF-90 includes multiplier for six meter output $29. AOF-91 includes multiplier for 6/2M output $36. 6BH6 osc., OB-2 VR, 12BY7 buffer-amplifier & multipliers.

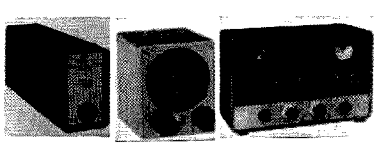
AOC 6 and 2 meter converter kits. Cascode nuvistor rf. Noise figure of less than 3 db. Standard IF 28 mc, others available on request. Less power supply. AOV-6 for 6 meters. AOV-2 for 2 meters. $59.50.



AOR receiver kits. Superhet circuit with regenerative second detector. Nuvistor rf amplifier. Additional Add-On-Circuits may be used to expand these basic receivers. AOR46 six meter; AOR47 two meter are $66.50. All AOR receivers include power supply and 4" speaker.

Johnson

**E. F. Johnson Company
Waseca, Minnesota**



The 6N2 Converter (left) converts 6 and 2 meter signals to 1 of 4 *ifs:* 26-30 mc, 28-30 mc, 14-18 mc, 30.5-34.5 mc. Bandswitching and self contained power supply. Size: 5 h, 2¾ w, 12 d. Weight: 2 lbs. Price: Kit, $59.95; Wired, $89.95.

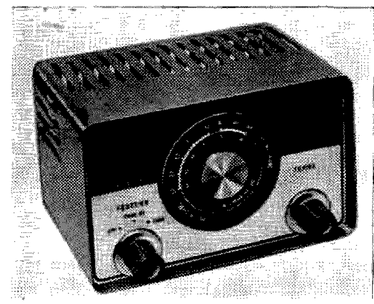
The 6N2 VFO replaces 8 to 9 mc crystals in any 6 or 2 meter transmitter. Includes a VR tube but requires external power. Size: 4 w, 5 h, 4½ d. Weight: 2 lbs. Price: Kit, $34.95; Wired, $54.95.

The 6N2 is a bandswitching transmitter for 6 and 2 meters. Requires an external power supply and modulator. 150 watts input CW, 100 watts AM *to* 5894. TVI *suppression.* may be driven by any 8-9 mc VFO or crystal. Size: 8⅜ h, 13⅛ w, 8½ d. Weight: 10 lbs. Price: Kit, $149.50; Wired, $194.50.

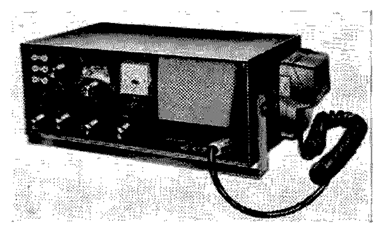
The 6N2 Thunderbolt amplifies a 5 watt input signal to 1200 watts PEP SSB, 1000 watts CW, or 700 watts AM. Silver plated tank circuits, *2-7034* final amplifiers, self contained power supply. Size: 21 w, 11⅝ h, 16½ d. Weight: 120 lbs. Price: $549.50 wired only.

Lafayette

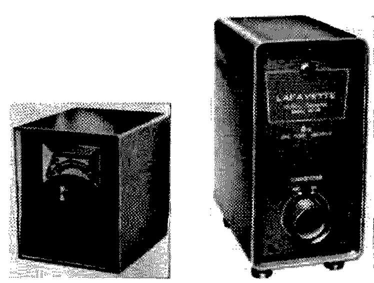
**Lafayette Radio
111 Jericho Turnpike
Syosset, L. I., N. Y.**



HE-89 6 and 2 meter VFO. Built in power supply. 8-9 mc output. 6¼ x 4½ x 4. $29.95.



The HE-45-B a 6 meter transceiver with 14 watts input to a 2E26 final. Built-in 12 and 115 volt supplies and speaker. Pi-network, external VFO input, S-meter, spotting swtich, noise limiter, superhet receiver. Size: 5 h, 12 w, 8½ d. Weight: 15 lbs. Price: $119.95.

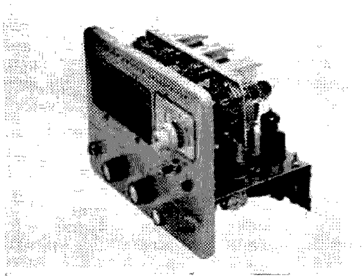


The HE-61A (left) is a 6 meter VFO with 8-9 mc output for use with most 6M transmitters and transceivers. 2 tubes, power cable, crystal plug, less power supply. Size: 3¾ w, 4¾ h, 4¼ d. Weight: 3 lbs. Price: $19.95.

The HE-56 (right) and HE-71 are 6 and 2 meter converters, respectively, converting 50-54 mc and 144-148 mc to 7-11 mc. 2 tubes in HE-56, 3 *in* HE-71, self-contained power supply. Size: 7⅝ h, 3½ w, 5⅝ d. Weight: 6 lbs. Price: HE-56, $29.95; HE-71, $32.95.

Lawrence

Lawrence Engineering Co.
36 Lawrence Road
Hamden 18, Conn.

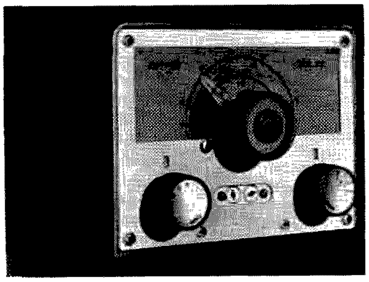


Twoer modification kit. Fits in case of Heath Twoer with no changes in power supply, no cable changes. Makes Twoer a superhet with increased selectivity and sensitivity and no receiver radiation. $33.90.

Sixer modification kit. Similar to above, but for 6 meters. $34.85.

National

National Radio Co.
Melrose, Mass.



The VFO-62 is a 8-9 mc vfo for use with any 6 or 2 meter transmitter. Self powered, crystal socket, bandswitching, spotting switch. Size: 5¼ h, 6½ w, 5½ d. Weight: 6 lbs. Price: $49.95.

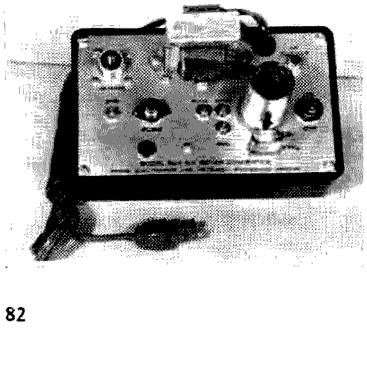
Olson

Olson Radio
260 S. Forge Street
Akron, Ohio

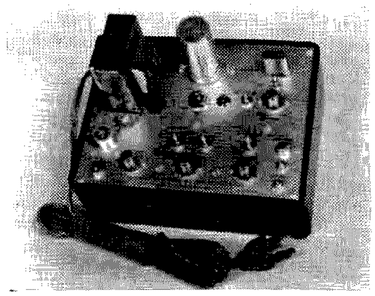
Olson 6 Meter transceiver, 100% modulated 15 watts input, double-conversion receiver with crystal controlled first oscillator. .5 mcirovolt sensitivity. Tunable BFO, Built in power supplies for 117 v and 12 v includes push to talk mike, 4½ x 12½ x 7. $139.98.

Parks

Parks Electronic Laboratory
Route 2, Box 35
Beaverton, Oregon



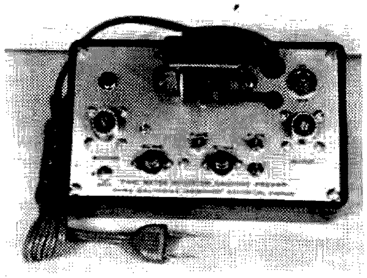
The Model 50-1 6 meter converter uses a 6CW4 and 6U8A to give output on 7-11, 10-14, 14-18, 26-30, 27-31, 28-32, or 30.5-34.5 mc. 1.5 mc bandwidth, self-contained power supply, choice of connectors. Price: $34.50.



The 144-1 is a cascode nuvistorized 2 meter converter with possible *if*s of 7-11, 10-14, 14-18, 22-26, 24-28, 26-30, 27-31, 28-32, 30.5-34.5 or 50-54 mc. 4 mc bandwidth, choice of connectors, 3 db noise figure, power supply included. Price: $54.95.

220 mc nuvistor converter. Similar to 2 meter converter. $54.95.

432 mc nuvistor converter. Similar to 2 mc converter. $54.95.



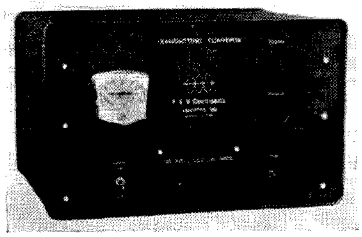
The 144-1P 2 meter preamplifier uses 2 nuvistors to give a 2.5 db noise figure. Built-in power supply, 4 mc bandwidth, UHF connectors. Price: $25.00.

220 mc nuvistor preamp similar to 2 meter preamp. $25.00.

432 mc nuvistor preamp similar to 2 meter preamp. $25.00.

P & H

P & H Electronics, Inc.
424 Columbia Street
Lafayette, Indiana

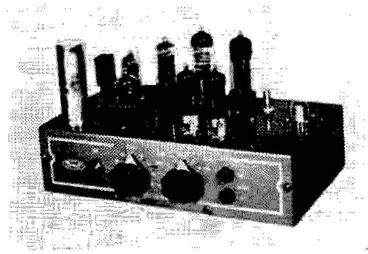


2-150 transmitting converter. Converts 20 meter output of any exciter (AM-SSB, etc) to two meters. 7854 final, 175 watts PEP on SSB, 165 watts CW, 90 watts linear AM. Built in power supply. 9" x 15" x 10½", 45 lbs. 10-100 watts drive required. Well metered. $329.95.

6-150 transmitting converter. Almost the same as the 2-150 except converts 20 meters to six meters, final 8117. Price $299.95.

Tecraft

The Equipment Crafters
Box 84
South Hackensack, N. J.



The Criterion converters are available for 50-54, 144-148 and 220-225 mc. Outputs available from 6-50 mc, built-in power supply, 2 tubes, 2 nuvistors, 4 mc flat bandpass. Price: $54.95.

The Tecraft transmitters are available for 50, 114 and 220 mc. All include one crystal and have 6360 final at 20-25 watts input. Plate modulation, less power supply. Price: $65.95, power supply $39.95.

Utica

Utica Communications Corp.
2917 W. Irving Park Road
Chicago 18, Illinois

The Utica 650 is a 6 meter transceiver with VFO included. It features 22 watts input to a 2E26, 3 kc selectivity, dual conversion, spotting switch, S-meter, adjustable BFO, built in power supplies for 12 and 120 volts. ANL, push to talk, microphone, ac power cord. Price: $189.95. 12 vdc power cord $3.95.

Vanguard

Vanguard Electronic Labs
190-48 99th Avenue
Hollis 23, N. Y.

6 meter 150 mw 4 channel transis torized transmitter with AM modu lator. Includes transistors and 50.! mc xtal. Requires 12 volts at 35 ma $14.95.

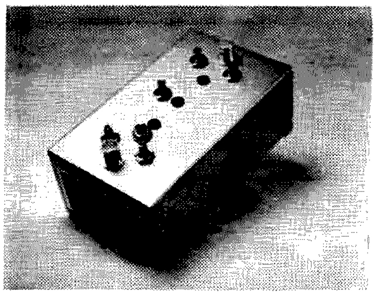
Transistor converters. 3 VHF trans istors, crystal included. 3 x 2¼ x 2 Tuned rf state with better tha 1 microvolt sensitivity. 12 v DC 300-B 50-51 mc, *if* .6-1.6 mc $10.9 300-C 50-54 mc, *if* 14-18 mc $10.9 300-D 144-148 mc, *if* 50-54 m $12.95. 300-E 144-145 mc, *if* .6-1. mc $12.95. 300-F 144-146 mc, 28-30 mc $12.95. 300-X 1 input an 1 output frequency between .6 an 160 mc $14.95.

Mark 3 transceiver covers 49.5-54.5 mc. Crystal controlled 200 mw transmitter. Includes whip antenna, handset. 6½ x 11 x 3¼. Wt. 4½ lb. $69.98.

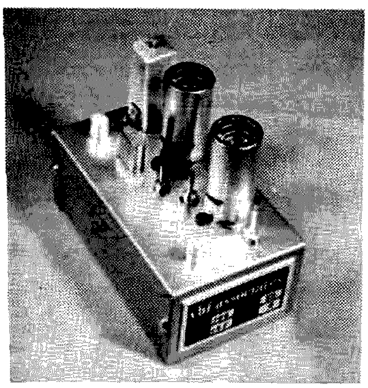
Vanguard nuvistor converter uses a 6CW4 pre-amp and 6U8A converter. 2.5 db noise figure. Output on 14-18 mc or .6-1.6 mc. $10.00.

VHF Associates

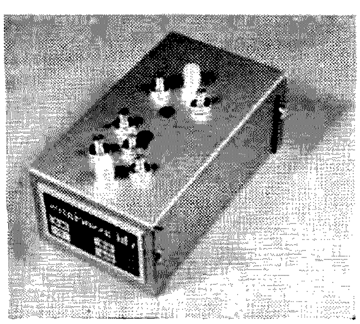
VHF Associates
P.O. Box 6401
Denver, Colorado
VHF-UHF Frequency Doubler 2132. Driven by up to 20 watts PEP AM or 20 watts carrier FM or CW. on 216 mc. Output 12 watts PEP AM or 12 watts carrier FM or CW. No power supply required. 50 ohms impedence, BNC connectors. 3 x 5¼ x 2¾. $54.95 wired and tested, $49.95 in kit form.



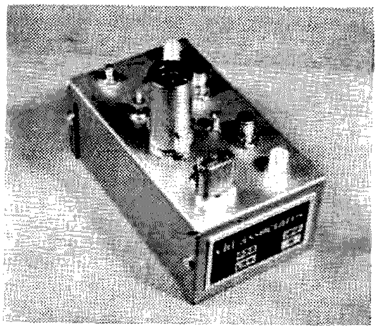
VHF-UHF Frequency tripler 1432. Same specifications as above except input is 144 mc.



Iodel No. 145 2 meter converter. ' 50 to 54 mc. Noise figure better ıan 5 db. Gain more than 25 db. equires 100 to 150 vdc and 6.3 v. x 5¼ x 2¾ in. Price $22.95.



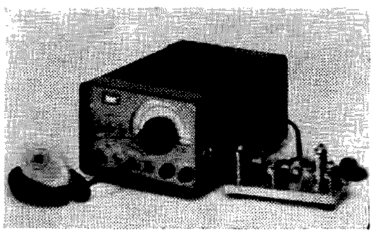
Model 514 Varactor Tripler from 48 to 148 mc. Drive requirements: up to 20 watts RF. Output: 12 watts PEP on AM, 12 watts carrier on FM or CW. No primary power required. Size 3 x 5¼ x 2¾ in. $54.95.



Model 4314 (2 meter output) and 4322 (1¼ meter output) nuvistor converters for the 432-436 mc band. Noise figure 6 db., gain 18 db. use 2 6CW4 and a 6J6. Power required, 100 to 150 vdc and 6.3 v. Size 3 x 5¼ x 2¾. $44.95.

Whippony

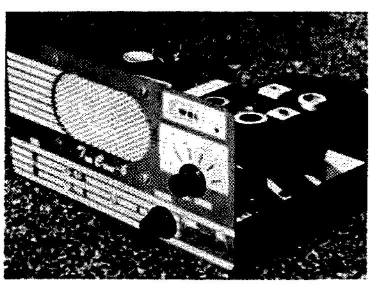
Whippany Laboratories
1275 Bloomfield Ave.
West Caldwell, N. J.



The Li'l Lulu 6 meter transmitter has VFO coverage, 50-54 mc with tracked multiplier and final stages. Extensive shielding and built in low-pass filter. Built in 115 and 12 volt power supplies, push to talk switchable AM or CW, accepts crystal or carbon mike. 5 watts output on phone, 5⅜ x 8 x 11⅜. Weight 16½ lbs. Price. $225.00.

WRL

World Radio Laboratories
3415 West Broadway
Council Bluffs, Iowa



TechCeiver TC6-A 6 meter transceiver. Superhet receiver with rf stage, crystal controlled plate modulated 1 watt transmitter with push-to-talk. 10 tube sections (6 tubes) and 2 diodes. Speaker included, 5 x 9¼ x 6. Weight 5¼ lbs. Price: $39.95 less power supply. AC supply, $15.95. 12 volt DC supply, $29.95.

Antennas for VHF

Antenna Specialists
12435 Euclid Avenue
Cleveland 6, Ohio
6 and 2 meter verticals for mobile use. 6 and 2 meter coaxial and ground planes. Combination 6 and 2 meter coaxial antenna for mobile use.

Cush Craft
621 Hayward Street
Manchester, N. H.
Yagis for 6, 2, 220, and 432 with stacking kits available for duals and quads. Dual 6 and 2 meter yagi. 6, 2 and combination 6 and 2 meter halos. 16, 32 and 64 element colinear arrays for 2, 220 and 432. Ground planes. Squalo for 6. Big Wheels for 2, 220 and 432. Twist for tracking satellites. Zipper portable beams for 6 and 2.

Finney Company
34 West Interstate
Bedford, Ohio
Combination 6 and 2 meter beams with stacking kits available. 6, 2 and 220 yagis.

Gain, Inc. (Importers)
1209 West 74th Street
Chicago 36, Illinois
Skeleton Slot J-Beams for 6, 2, 220 and 432 with stacking harness and add-on kits.

Hy-Gain Antenna Products Corp.
N.E. Highway 6 at Stevens Creek
Lincoln, Nebraska
Yagis for 6, 2, 220 and 432 with stacking harnesses. Standard and center mount halos for 6 and 2. Ground planes for 6 and 2. Jay-Pole Stacks for 2. Duo-Bander beam for 6 and 2. Log Periodic for 6 and 2. Duo-Band ground plane for 6 and 2. Discone for 50 mc through 500 mc. Verticals for 6 and 2 for mobile use.

Hi-Par Products Company
Fitchburg, Mass.
Saturn 6 Horizontally Polarized Antenna for 6. Lunenburg 2 meter Halo. 6 meter Broadband Ring Antenna for Fixed Installations. Yagis for 6 and 2. Hilltopper Portable Beams for 6 and 2.

Lafayette Radio Corporation
111 Jericho Turnpike
Syosset, L. I., N. Y.
6 meter ground plane. 6 meter verticals for mobile use.

Medicom
Box 632
Soulsbyville, California
Flex-A-Ray for 2, 220 and 432.

Master Mobile Mounts
4125 W. Jefferson Blvd.
Los Angeles, Cal.
2 meter J. 2 meter cloverleaf. 2 meter twin six beam. 6 meter beam. 1½ wave colinear ground plane for 2. Verticals for mobile use. Ground planes.

Mosley Electronics
4610 N. Lindbergh Blvd.
Bridgeton, Missouri
2 meter Scotch-Master beam with stacking kits. 6 meter Scotch-Master beams.

New-Tronics
3455 Vega Avenue
Cleveland 13, Ohio
Conveya 6.

continued

Oklahoma Center VHF Club
c/o Bob's Amateur Electronics
1139 N. May Ave.
Oklahoma City, Okla.
Vertical J for 6.

Super-Q Products
3363 Verner Rd.
Kent, Ohio
6 meter beam.

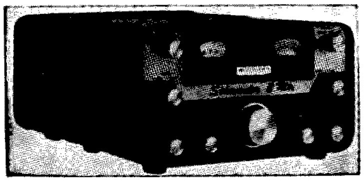
Telrex Laboratories
Asbury Park, N. J.
Yagis for 6, 2, 220 and 432.
6 meter Spiralray.

World Radio Labs
3415 West Broadway
Council Bluffs, Iowa
6 meter colinear ground plane. 6 meter beam.

Addendum

Gonset

Gonset Inc.
801 South Main Street
Burbank, California



Gonset Sidewinder. Two meter transceiver, SSB, AM, CW, mobile or fixed, PTT, two speed tuning dial, tunes 1 mc, bandswitches for each of the four mc, receiver transistorized for compactness and low drain, transmitter transistorized except mixer, driver and final. Crystal lattice filter. S-meter. 20 watts PEP to 6360 final, 6 watts AM. Transistorized power supply fastens to rear of transceiver. Draws .05 amps at 12.6 vdc in receive position, 1 amp for transmitter standby, 8 amps during transmit. Power supply operates from 12 vdc or 117 vac. 8¾" w, 4¾" h, transceiver 7" d, power supply 5½" d. Weight 19 lbs. Sidewinder: $349.95. Power supply kit $39.95, wired $49.95.

Disclaimer

We've tried hard to get everything right in this section, but it is always possible for us to get a price or a model number wrong, or even to leave out units which obviously should have been included. Injured manufacturers should let us know so we can do better next time.

A Ham's Eye View of the Alaskan Earthquake

Les Haye KL7CKQ
Box 946
Anchorage, Alaska

I had just arrived home from the office a short time before the earthquake struck our area. From the immediate violence of the shake, I realized that we were in for massive damage in the Anchorage area.

For the duration of the earthquate, I had my hands full trying to remove one granddaughter from the danger area where pictures and mirrors were falling from the wall, while my daughter-in-law, René, was trying to calm my wife, Margaret, who was almost hysterical over all of her nice dishes flying from the cupboards and crashing to bits on the floor. The other granddaughter was fairly safe on a bed in the bedroom. I remember thinking at the time that I hoped we were not sitting on top of a volcano which was about to erupt. Some of the neighbors told me that their chief concern was whether my 52'unguyed tower would come crashing down. The beam was slightly damaged but the tower came through unscathed.

My amateur radio station KL7CKQ sustained a considerable beating around but seemed to be in an operable condition; however, we had no elecericity, gas, heat or water so the big transmitter was temporarily unusable. I proceeded with immediate installation of the 2-meter (CD coverage) mobile transmitting and receiving facilities into my car. This posed a minor problem due to the use of an exchange battery which did not have the proper battery connections. This was overcome by cutting the battery clips from my battery charger and "haywiring" them to the battery. My son, Jim, KL7EKD, had a difficult time locating my mobile antenna in the jumbled mess the earthquake had made of my storage building. However, it was found i

6Up

Our VHF magazine is now rounding out its first year and is doing very well for itself. It is running 28 to 36 pages per month and is well enough supported by advertisers so you know it is going to stay in business. This is the only source of up-to-the-minute news of VHF activities, conditions, equipment, regulations, politics, etc. If you do any operating on the VHF's or UHF's you should be getting 6Up. Only $2 per year. 6Up, Peterborough, N.H.

usable condition and placed into service.

Upon getting the "two meter" apparatus into operation, I checked into the CD net from the car and was advised that they had no immediate need for my mobile services. At this time, Dan Wright, KL7ENT, having been forced from his home by the shake, had placed his mobile high-frequency transmitter into his car and arrived at my place. We made immediate preparation to get on the high frequency amateur bands from his car. Wiring torn loose in his automobile by the severity of the earthquake was hastily repaired and Station KL7ENT, operating mobile on a whip antenna, went on the air. Immediate contact was made on 75 meters with Horace's W7AG in Suquamish, Washington, and Horace relayed to our relatives that all the respective families here were all right and the homes damaged but safe. Horace, an old friend of Dan's was monitoring on the frequency commonly used by Dan and him to establish nightly contact via amateur radio. Horace said it was with extreme relief that he heard Dan calling him and realized that he was OK. Almost continuous contact was maintained throughout the period from 8:45 on the evening of the quake continuing for several days.

While Dan set up contact with Horace, I cut the cable lacing on my big transmitter and removed the various antenna lead in cables for the fixed antennas and made provisions to hook these antennas to the mobile transmitter and receiver in Dan's car. These large permanent antennas would give better signal strength and coverage. We then set about the almost insurmountable task of providing some of the first communications between the disaster area and the outside world. This was about 8:45 on the evening of the calamity. While Dan operated the "mobile portable fixed" station, I set about coordinating between the CD facilities with the transmitter in my car, running information between my car and my house, and to Dan in the mobile station. By this time, my son, Jim, was busy hunting gasoline to keep Dan's car running since all the service stations were out of commission. Gasoline was donated by Ken Stocker. Other good samaritan neighbors moved in to make fuel available to provide the motive power for the mobile station.

About this time one broadcast radio station had gotten into operation and we were receiving information on my portable transistor radio. The operation of the broadcast station was a godsend to us since we were able to communicate with them by telephone which fortunately was undamaged and operational on the Fairfax Exchange all through the emergency. Many messages from Fairbanks and the 48 states were relayed directly to the radio station to avoid the disruption of the CD net. Dan operated throughout the night handling incoming and outgiong traffic until about 4:30 A.M. when the 75 meter band "went out." Dan was so fatigued and hoarse from his all-night vigil that he sounded more like a big bullfrog than anything else. We tried unsuccessfully to sleep until 6:30 A.M. at which time we switched to 20 meters and my Telrex tribander and prepared for the grueling task of continuing the emergency communications to the outside on the 20 meter amateur frequencies. Again Dan bore the brunt of the constant talking with some assistance from me, KL7CKQ, Andy, KL7ARY, and Frank, W5GEG. I continued with the leg work between the phone, broadcast station, and the mobile radio station, trying to keep abreast of the stream of incoming and outgoing messages.

Nearly all the messages throughout this period were damaged and welfare information between Anchorage, Fairbanks, and the "South 48." As an example, an appeal went out for bread via the broadcasting station which was being received at Fairbanks. Almost immediately we handled the incoming answer to the appeal with the information that the bakery in Fairbanks had received the message and 700 loaves would be in by plane in the early morning. Messages of this type became almost routine.

Other traffic from the outside included a multitude of offers of aid, personnel, and supplies ranging from blood, plasma, and medical supplies, to heavy machinery with operators, as well as telephone facility supplies with trained personnel and offers of money and food. These were all placed into the proper channels with answers back to the originating stations as soon as possible.

Since communications was of vital importance, in answer to a query by the Postal Inspector at San Francisco as to damage to facilities here, the Postal authorities were contacted through the broadcasting station. The Postmaster called me almost immediately and we were able to relay back through our station that all post office personnel were OK with minor damage to the Post Office facilities. This meant that mail could be worked. We were able to answer queries from the airlines and inform them that the International Airport was closed to jet traffic which was being accepted by the Elmendorf Air Force Base facilities. At about 2 AM we handled an urgent request for generators and dynamite from

Seward. This report, as well as a rundown of damage to the railroad terminal, dock, and tank facilities, was immediately placed into the hands of the proper authorities.

This has been a cross section only of our first operations since there were such a multitude of messages worked throughout this time that it would be impossible to tabulate them here. However, we should note the fact that candles and flashlights supplied the only lighting available with no heat or drinking water. This compounded the difficulties but the situation was alleviated to a certain degree by the welcome advent of a portable gasoline stove supplied by Andy, KL7ARY, and coffee made from melted snow.

At about noon on Saturdaay we started to get electricity back. When this would occur we would change the antenna to the big KL7CKQ transmitter and handle the traffic through that facility since we could run much higher power. The power would fail occasionally and an immediate transition would be made back to mobile KL7ENT with a negligible time lag. This went on throughout the day with a nighttime transition to the mobile station when the 20 meter band failed and forced us back on to 75 meters.

As soon as possible we had the radio broadcasting stations begin giving broadcasts that we were in a position to start handling outgoing welfare messages to the outside. An immediate landslide of messages hit us with the streets in front of 3215 Lois Drive and 915 Engle Street lined on both sides with automobiles, and many people coming to the house on foot. It must have been a tremendous emotional release to the frantic public to know that contact could be made with their worried relatives, many of them sick and ailing.

Mrs. Marjory Cook, my daughter-in-law, René, and my wife, Margaret, were pressed into service to copy messages and feed them to the operator of KL7CKQ or KL7ENT as fast as they were written. All messages were worked as soon as possible with priority given to emergency messages. We were running as many as 100 messages behind at times, but handling as many as 219 per day. These messages were the telephone collect type with the instructions to the receiving station, who was given from 5 to 25 messages, that he step to the telephone and phone them through while we were giving the next station from 5 to 25 messages. By this type of operation we were able to deliver at least 98% of the messages with no time lag.

With the restoration of power, Dan, KL7ENT, had returned to his damaged home and placed his big station into operation. This doubled our traffic handling capacities with liaison between the two stations provided by separate 2-meter station facilities. The story of his operations from this point on would fill another volume.

I think at this time it would be interesting to give a little cross-section of the sometimes pathetic, sometimes urgent, and sometimes humorous situations encountered. The overall morale of the people we met, many homeless and confused, was terrific. There was little evidence of panic. Talk would sometimes turn to reconstruction of their battered businesses or homes with the greatest concern being given to getting word to relatives.

As an example of the varied messages handled, one lady came to us and asked if we could possibly help her since her brother and some friends had chartered an airplane and were waiting for clearance from the authorities here to come after her body. She flatly stated, "I am not a body." We assured her that we could and would help her and asked where the message was to go. Needless to say we received a shock when she said, "Paris, France." This slight difficulty was resolved when we learned she had a relative in an outside state. We gave them the telephoned information, requesting them to send a cable with the welcome news to her waiting relatives in France.

Another similar situation involved an ailing father in Lebanon. This was complicated by the fact that the party did not have the relative in the states. The difficulty was quickly resolved by my Net Control Station K7VJJ, Keith, who stepped to the telephone and sent the necessary cable to Lebanon at his own expense. A check was dispatched from the joyous relative to Keith for the amount of the cable

We also had a sort of a humorous inciden of a continuing nature. We had several querie from a large cheese factory wanting to donat 1000 lbs. of cheese. For about three days th Red Cross was constantly queried for shippin instructions. Under the pressure at that head quarters the answer failed to get back to u until we finally elicited the information th they did not want the cheese. This informatio was sent back to the people at the factor They asked us to give the donation to anyon who could use it. The American Legion w contacted. They eagerly accepted and shippin instructions were provided to the factory.

In another instance we had information th a lady was in a hospital in California wi shock, and information was obtained that h daughter and family were safe. This inform

tion was dispatched to her via telephone. I can't give more than a small cross section of the messages handled, however, I would like to give a few sidelights on the operation.

One of our very faithful contacts in California who had been pushing messages for all he was worth, came back on a transmission and said to me, "Les, all of these messages say the same thing (we are safe, etc.). They don't seem to be very important to me." I went back to him and said, "Lloyd, if I received one of these messages it would be the most joyour and important message in the world to me." Lloyd came back and said, "I hadn't thought of that, shoot me some more messages."

I believe that it is proper at this time to say that the radio amateurs throughout the world reacted to this emergency in a wonderful way. Frequencies and bands were cleared for the outgoing traffic with many stations policing the frequencies being utilized for emergency or disaster traffic. Very little interference was encountered, and thus the transmission of these thousands of messages was possible. I can't praise all the fellows enough foh the teriffic way they moved in to ease the burden here during those dark days.

There were constant queries from stations throughout the states, but since we could not handle incoming messages as all phones were limited to emergency calls, all such questions were necessarily turned down and believe me, it was heart breaking to have to take such a course. However, had we not done this we would have been completely snowed under with traffic for which there were no answers.

To help alleviate this constant desire for nformation, I asked the girls who were taking nessages to make notes of all information coming through on the radio regarding damage, asualties and general conditions in the state, s fast as they were made public. I would then ake a brief break and read these accumulated eports to the thousands of amateur stations ionitoring our transmissions. It was pointed ut at the time that we did not know how ccurate the information was but were offering since this was all the information we would ave for some time. We thus answered thounds of unasked questions with a minimum ne delay. We were told later that such transissions did a tremendous job to allay the ars of a nation who temporarily had no other urce of information. I fact we were told that ews media constantly monitored our transissions with dissemination through news fa-ities as fast as it was received.

There were constant offers of cash for our services by those taking advantage of them and they seemed a little surprised when we said *No Charge*. We had to explain that these stations were licensed by the FCC as amateur activities and that the service now being rendered was a working example of the public service offered at any time by the members of a closely knit fraternity.

I would like to extend my special appreciation at this time to John Meyers, K7DPH who came in and spelled me on the transmitter through the many long hours. He gave his time and energy unstintingly to keep KL7CKQ on the air and the traffic moving.

I would like to thank all the people who came in and offered to help even though they themselves needed help.

I would like to especially thank Sgt. Gilstrap of the 2868 GEEIA Squadron, Elmendorf AFB, who made his way to my home to offer his assistance in the station operation as soon as the roads became passable.

I now want to offer my heartfelt thanks to those many amateur operators who patiently stood by on the frequency we were using to be ready to handle the traffic as fast as possible. It is only through such cooperation that it was possible to handle such a massive bulk of messages.

This is the behind the scenes story of those continuing radio announcements you received on your broadcast radios telling you to take your welfare messages to Station KL7CKQ at 3215 Lois Drive or to Station KL7ENT at 915 Eagle Street.

(W2NSD from page 4)

new breed of ARRL director. The responsibility is entirely up to the ARRL members to get good men into the directors' chairs. Have you anyone in your club or in your town that would make a good director? Someone who has been keeping up with current amateur events, a fellow who is intelligent and dedicated to our hobby? He also has to have been an ARRL member continuously for fou years and have a General or better clas license . . . no Conditionals or Technicians no matter *who* they are. Once you have good man in mind you have to sell him o wanting the job. Then you have to send nominating petition into headquarters wit ten signatures of current ARRL members. I' have more info on this next month for you.

Elections this year are for the Central, Huc son, New England, Northwestern, Roanok Rocky Mountain, South Western and We

Gulf divisions. Please fellows, we *must* have some good directors elected this year. Let's not get stuck with chaps who are out only for personal prestige.

WA2USA

As of this writing WA2USA has been put off the air as a result of the industry of ARRL errand boy Dannals who, with his cohort Stan Zak, is planning to run for Director next year. We understand that Dannals, Kahn and Booth requested permission from the officials in charge of the Venezuelan pavilion to have the ARRL take over WA2USA. This was an obvious way out of the hot spot ARRL was in due to the rising complaints about their "hidden" station K2US and growing dismay over the commercialism of their tie-in with "Drink Coca-Cola." It is particularly unfortunate that the good of amateur radio has become so completely submerged.

Salaries

Are there any other members of ARRL besides myself that would like to know something specific about headquarters salaries? Who are we paying how much? How much is

(Turn to page 90)

73 Products and Publications

6UP Magazine. The only fullfledged monthly devoted to VHF. Invaluable to the Technician and the VHF/UHF DX'er and experimenter. Activity reports on all band openings. Wide band FM news. Six meter news. Two meter news . . . 220, 432, 1296 . . . etc. Construction articles, antennas, etc. K5JKX editor. **$2 per year.** Don't miss a single copy of this interesting magazine.

ATV Bulletin. The Amateur Television Experimenter is the only publication devoted to ham-TV. Circuits, operating news, conversions of surplus gear, ads for TV gear, discussions. WØKYQ editor. **$2 per year,** published bimonthly.

Back Issues of 73. All back issues of 73 are available for **50c** each except June 1962 and January 1961, which are unavailable, and Oct-Nov-Dec 1960 issues, which are $1 each. We'll *pay* $1 for a January 1961 or swap for it.

Binders. Bright red leather gold stamped with 73 and year. Specify 1960-1, 1962, 1963, 1964. **$3.00 each.**

Bound Volumes. Only a few left. 1960-1, 1962, 1963. A very few. Beautiful red leather. **$15** each.

WØKYQ editor. **$2 per year,** published bi-
Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. **$1.00**

73 Inc

Peterborough, N. H.

(W2NSD from page 89)

the General Manager getting with his new improved raise? How much will Budlong get in retirement with his new raise? Aren't we members entitled to know where our money is going?

Publicity

The May 30th Post has a fine article on how hams have formed a communications network to link eye banks around the country. There have been quite a few local articles on this network in newspapers too. This is the sort of public service that makes ham radio worth its salt. All of us owe a vote of congratulations to the eye bank net.

Progress

One of the great areas for pioneer work in ham radio is in the VHF's. We've had two major historical events just recently in this field. On April 11th W6DNG contacted OH1NL on two meters via moonbounce (nearly 5000 miles away). The signals were S2 and S3, but they *were* signals. These fellows didn't have very spectacular stations either, using persistence over about two years to make up for a lack of antenna elements or a big dish.

Sam Harris W1FZJ (W1BU) was getting echos back on two meters about six years ago, but he was unable to get anyone else to set up and try to work him. He decided that he might be able to do better on 1296 and, sure enough, Eimac set up a station in California, provided him with a transmitter, and the record was made. I'll bet he'll be back up on two meters before long now.

Not that Sam has been taking it easy since his 1296 record. On May 19th he fired up or 432 mc and worked KP4BPZ in Arecibo Puerto Rico, a distance of about 1650 miles Sam was running his usual kilowatt and feed ing his 28 foot dish. The dish was lying o the ground tilted up against a pole so h could run out and swing it to follow the moon Contact was made with signals running be tween 20 and 40 db above the noise. Anothe record.

It must be admitted that most of the wor on this contact was being done down i Arecibo where Gordon was using the 100 foot dish built right into a depression in th mountains for his antenna. This gave him gain of about 56 db. When you figure th my little 336 element beam can have abo 28 db at the very best you can see that tl 1000 foot dish *is* advantageous.

Due to the location of the big dish the moon comes into range only about two hours a day for about two weeks each month. Most of this time is spent in scientific observations. On occasion Gordon finishes up some tests early and has a few minutes to tune up on 432 and see what he can work. He is planning on being on 432 for the entire two hour period for the June 13th day of the ARRL VHF party so we may see the distance record broken again in a few days. On the 14th he will fire up on two meters and see what can be done there.

If you've followed my writing much you probably know that this has bugged me considerably. I'm in the process of getting rather well set up on two meters. Unfortunately my monster antenna is aimed at the horizon and not at the moon. We could hit the moon at its setting time, but it would swing through the width of the beam pretty fast. This means that if we're going to try mooning it we'll have to start over and hook up a whole new antenna just for that. I don't know if we're going to be able to do that or not.

432 is probably my answer. We have a 192 element Cushcraft beam for that band on hand and it isn't too big to swing around on a polar axis. That still leaves me with a need for a good converter and a final amplifier. Neither of these seem to be made these days and I don't have the time to cook them up... what'll I do? My best bet is to write about the fellows who are able to build gear for these bands and make the contacts and not try to do it myself. This will leave some time for putting out 73 and working on the Institute.

In view of the events of late this special VHF issue is rather timely. One thing I'm trying to get across is that most of the gear for these bands can be built up very simply. We're starting a series of articles by K1CLL in this issue . . . they will go on for a long time to come. Bill Hoisington (ex-W2BAV) has been around the VHF's for a long time now and is nothing short of a wizard. He builds most of his gear on copper clad laminate which he picks up surplus from Meshna. The other main building material is flashing copper . . . soft copper which you can buy at a plumbing store. Nothing Bill ever builds costs much. He uses the least expensive tubes he can find, with the 2C39 being just about the highest price one in his repertoire.

The other day Bill was sort of at loose ends and asked for a suggestion for something to build. "How about some linears for the Sixer and Twoer?" I asked. A couple days later he drove up with working models which

gave a solid 25 watts output and were so simple to make that everyone here gaped in disbelief. The only power supply was a 500 volt TV job . . . no bias required. The on-the-air reports were wonderful. We can't have everything in one issue so these little marvels will be along in a couple months for you. Bill got quite a laugh at the Swampscott Convention when he attended a lecture by a VHF Expert who started right off telling everyone that Class B linears were much too inefficient and were no good.

The VHF's can be a lot of fun and it needn't be expensive to get there. You have to make your choice . . . monthly payments for new equipment or monthly repairs on old . . . or else you can follow Bill with the tin snips and soldering iron. You probably won't be nutty enough to buy a mountain to hold up your antennas, and it isn't really necessary. Though I've done a lot of mountain and building topping down through the years, I've also done a fair job of working DX right from the old homestead in Brooklyn. I used a 24 element beam (four six element yagis) with 500 watts and worked sixteen states and all the way out to Chicago on two meters.

Now, with a nice mountain shack, I hardly know which way to turn. Six, two, 220, and 432 all beckon. There's moonbounce, TV, WBFM, aurora, SSB, and even RTTY.

The next time you get frustrated by the QRM on 75 meters you might give some thought to wide open spaces up above ten meters. Actually the W.O.S. start around 15 meters most of the time these days, but it isn't until you get up to six meters that you run into large concentrations of regular inhabitants together with W.O.S.

Activity on six and two varies between the use of simple gear with simple antennas for short range rag chews to monster stations for moonbounce, meteor bounce, aurora bounce and brute force no bounce. Operations take place from home, mobile and from mountain tops. I've run the gamut down through the years. Back in 1946 I helped open two meters with the first 522 on the band. In 1947 I was lugging it to the tops of mountains. By 194 I had it on top of the News Building in New York. The only signal that was outdoing me then was W2BAV, Bill Hoisington up in Rye, New York who had a fire tower on top of a mountain. All this two meter stuff did not keep me from working quite a bit of DX. The next time you are up visiting the CQ office you can look through my 20 year QST collection there and find where I've marked each mention of W2NSD in the DX column

There's a note on the cover of each issue telling which page to turn to.

Even today I get as much kick out of six and two as I do out of working something rare on twenty. I've accumulated quite a bit of gear down through the years. My two meter rig is powered by the power supplies and modulator from the old pre-war National 600 transmitter which I picked up in 1947 and recently siliconized. The exciter is an old 522 driving a Gonset linear. The final was $30 surplus. The big event is the antenna and location.

Way up on the side of Mount Monadnock, the highest peak in southern New Hampshire, is a six room house. Surrounding this house are three towers, the largest 120′. On this 120′ KTV tower is the biggest two meter antenna you've ever seen . . . 288 elements! This is made up on three 96 element beams, one over the other. The 96's are in fact plain little old 64 element colinear beams with two directors in front of each set of colinear ele-nents. In this way we get the advantages of he colinear beam and the added gain of the agi. Clever idea by Cushcraft. The 288 was wung in place last October, but the feed-ines had never been connected. This May, vhen the snow melted enough to get to the iouse we found that the beam was quite in-act, despite a rigorous winter and extremely igh winds.

Naturally we're anxious to see how the eam works. We first used a little six element agi on a pole and found that we could work asily 150 miles with the band closed. Then e got a 96 element beam on top of the tower nd found that we could hear every Twoer in lew York and New Jersey and got reports of) db over 9. This blew over two days before ie September DX contest last year, proving iat 2″ hardened steel pipe is not enough for beam of this size. Almost every station we ork from the mountain is in the same south-esterly direction so we decided to use the wer to hold the beam instead of a pipe and forget rotating it. Actually, in practice, we ill be able to rotate the beam about 120° if becomes important. To take care of the casional station off our major beam we're ing to swing a 48 element beam to the top the tower on a Ham-M rotator. This will be etty interesting when we get it perking.

Next Month

We're putting together a special transistor ue for you. Receivers, transmitters, convert-, transceivers . . . wait'll you see the collec-n. . . . Wayne

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	14	14	14	14	14
ARGENTINA	14	14	7	7	7	7	14	14	14	14*	21	14*
AUSTRALIA	14	14	14	7	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7*	7	7	7	14	14	14	14	14	14*
ENGLAND	7*	7	7	7	7	7*	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7*	7*	7	7	7	7	14	14	14	14	14	14
JAPAN	14	14	7	7	7	7	7*	7	7	7	14	14
MEXICO	14	14	7*	7	7	7	7*	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	7	7	7*	7*	7	7	14
PUERTO RICO	14	7*	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	14	7
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	7*	14	14	14	14

Good: 1-5, 12-15, 23-31

Foir: 11, 16-20, 22

Poor: 6-10, 21

Es: 1-5, 12-15, 27-31

(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

ALASKA	14	14	14	7*	7	7	7	7	7*	14	14	14
ARGENTINA	14	14	14	7	7	7	14	14	14	14	14*	14*
AUSTRALIA	14	14	14	14	7*	7	7	7	7	7	14	14
CANAL ZONE	14*	14	14	7*	7	7	14	14	14	14	14*	14*
ENGLAND	7*	7	7	7	7	7	7*	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	7	7	7	7	7	14	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7*	7	7	14	14
MEXICO	14	14	7*	7	7	7	7	7	7*	14	14	14
PHILIPPINES	14	14	14	7*	7	7	7	7	7*	7*	7	14
PUERTO RICO	14	14	7*	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	14	14	14	14	14	7
U. S. S. R.	7	7	7	7	7	7	7*	14	14	14	14	7*

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	7*	14	14	14	7	7	7	7	7	7	7	7
ARGENTINA	14	14	14	7	7	7	7	14	14	14	14*	14*
AUSTRALIA	14	14*	14*	14	14	7	7	7	7	7	14	14
CANAL ZONE	14*	14	14	7*	7	7	7	14	14	14	14	14
ENGLAND	7*	7	7	7	7	7	7	7*	14	14	14	14
HAWAII	14	14*	14*	14	14	7	7	7	14	14	14	14
INDIA	14	14	14	14	7	7	7	14	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	7	7	14	14
MEXICO	14	14	14	7	7	7	7	7*	14	14	14	14
PHILIPPINES	14	14	14	14	14	7	7	7	7*	7*	7	14
PUERTO RICO	14	14	14	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	7	14	14	14	14	7
U. S. S. R.	7	7	7*	7	7	7	7	14	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	7*	14	14	14	14

* Means next higher frequency may be useful. . .

The Institute of Amateur Radio

what • why • who • etc

WHY IS THERE A NEED FOR THE INSTITUTE OF AMATEUR RADIO?

1. Amateur radio has no representation in Washington.

a. Other users of radio frequencies have organizations in Washington to help protect their frequencies and privileges. See 73 April 64, page 18, for details. We, who have been constant losers, more than any other group, should be strongly represented. We've tried doing without; can we learn?

b. Other hobbies have organizations in Washington to keep in touch with the government, and protect the prilileges of the members against restrictive legislation and promote positive legislation. Good examples of this are the Aircraft Owners and Pilots Association, and the National Rifle Association. AOPA, being on the spot, was able to get legislation through Congress quickly, when they wanted alien pilots to be able to use their plane radios while in the U.S. Look how many years we've been trying to get reciprocal licensing.

c. The Institute of Amateur Radio will be centered in Washington, D.C. Four of the nine interim directors of the Institute are in the Washington area, and they are proceeding with the bulk of the organizational work from there.

d. One of the IoAR interim directors is an official representative and is in touch with the Senate, representatives of the administration, etc. The voice of amateur radio is being heard where it counts.

2. Nothing is being done to keep our government behind us.

a. We had very little support at the 1959 Geneva Conference. U.S. Delegates, representing the various users of radio frequencies, admitted that amateur radio was at the bottom of the list.

b. The Institute started in April sending a weekly newsletter to every U.S. Senator, every U.S. Representative, every state Governor, and all government officials involved with radio. This newsletter stresses the public service of amateur radio and the benefits to the country of our having a strong amateur service.

c. Government officials and Congressmen have an office to call when any problems come up regarding amateur radio. The Institute's Washington representative provides personal contact for all of us.

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a. The outlook for the next frequency conference is indeed black for amateur radio at present. Educated estimates are that we will lose 40 meters, plus parts of 80 and 20 meters.

b. The IARU is in bad shape. It was flatly turned down in Region 2 (North and South America) in April when president Hoover had no program to offer for saving our bands. Instead, a separate organization was formed with separate officers. IARU Region 3 (Australasia) is virtually unorganized. Region 1 (Europe and Africa) is partially organized, but may soon fall apart over lack of any program.

c. The Institute proposes to make club stations available to locals in DX countries who are trained in amateur radio by visiting DXpeditioners. This should help introduce amateur radio to newer countries. Several manufacturers have volunteered to supply equipment for this program.

d. The Institute plans to send out an international newsletter to government officials concerned with amateur radio, to point out the advantages of having a strong amateur service. All probable delegates to the Geneva Conference will also get this newsletter.

4. Amateurs fighting legal battles get little support.

a. Whenever an amateur loses a legal case involving amateur radio this sets a precedent which can then be pointed to in the future whenever a similar case is in contest. It is therefore of great importance for all precedent setting cases to be won.

b. Legal cases can be very expensive. WØJRQ has spent well over $1500 fighting a suit against his tower. People that moved into his neighborhood well after he had his tower up have sued him for $8000 damages to the value of their property because of the unsightliness of his tower. If he loses this case every amateur in the country with a tower would live in fear of a law suit for thousands of dollars and with a precedent for the suers to point to.

c. The Institute position is that cases like this are the responsibility of all of us, and that funds should be provided to help amateurs who, through no fault of their own, have to fight a suit which could hurt all of us if lost. The Institute has sent $500 to help WØJRQ with his case. With this support there is a good chance that the complainants may give up the case.

d. In Santa Barbara three hams have been prosecuted by the city as public nuisances to put them off the air. The entrance of the Institute into the case has evidently resulted in the city losing interest.

e. The Institute is investigating the possibilities of providing all members with an insurance policy to protect them from suits connected with amateur radio. The Institute intends to help as much as possible amateurs with legal battles involving amateur radio.

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a. ARRL admits that they do not represent the amateur (July 63 QST, page 9, paragraph 4).

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1. Exams to be given at hamfests and conventions under close supervision of clubs.
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1. Members
2. Directors
3. Coordinators
4. 73 Staff
5. Temporary secretary: Wayne Green

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1. See that our legislators and government get publicity about amateur radio via the publication of a weekly newsletter.

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Date ____________________

GENERAL INFORMATION

Name ____

Address ____

City ____________________________ State _________ Zip ______

Age ____________________

TECHNICAL INFORMATION

Amateur Call _________________ Class of License ________

How long have you had this Call? _________________________

What are your primary fields of interest in amateur radio?

Frequency Bands of most interest to you?

What type of operation do you prefer: ( ) Phone ( ) CW
( ) TV ( ) VHF ( ) RTTY ( ) Contests ( ) Other (list)

Please list any professional and/or amateur radio societies of which you are a member.

IoAR Membership Fee (one year) $10

Mail application and fee to:
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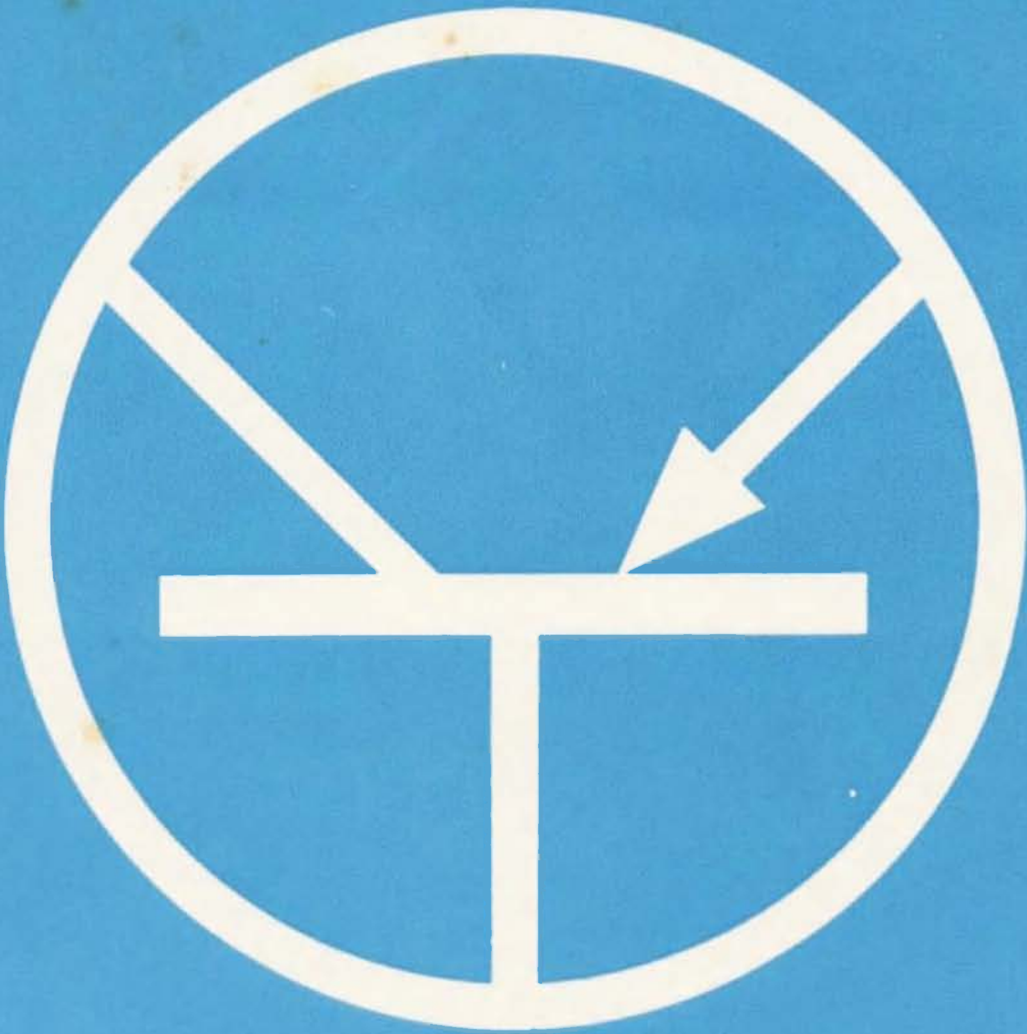
73

Amateur Radio

August 1964

A Tiny 40c



TRANSISTORIZED ISSUE

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

August, 1964

Vol. XXII, No. 1

73 Magazine is published monthly by 73, Inc., Peterborough, N. H. The phone number is 603-924-3873. Subscription rates $4.00 per year, $7.00 for two years, $10 for three years world wide. Second class postage is paid at Peterborough, New Hampshire and at additional mailing offices. Printed in the US.A.

Postmaster: please send form 3579 to 73 Magazine, Peterborough New Hampshire.

de W2NSD/1

never say die

It's too bad so few of you read CQ anymore. Their few articles may be dull, but you're missing hilarious editorials. In May and June they called me every nasty name they could think of and warned everyone that I was out to destroy the ARRL and take over ham radio. Beware.

The July editorial has a new boogey man. It seems they have discovered that a small group is trying to take over ham radio. They didn't explain what this means, but obviously it is bad news. CQ says that this group of schemers has been smearing ARRL on the air and via club bulletins. They have formed numerous societies and associations, have wormed their way into the amateur equipment industry, etc. Their purpose is to destroy the ARRL and "take over."

I mulled this over. My first reaction was one of pique. I expected to get another of their editorial treatments, and instead I've been relegated to the letter-to-the-editor trash dump. I'm last month's threat . . . I don't count anymore.

Then I started wondering what on earth they were talking about. I usually hear about everything going on in our hobby just before or just after it happens, but this one took some figuring. Perhaps CQ was referring to their own Clif Evans K6BX. Certainly he fit much of the description. He has been haranguing ARRL on the air at great length, has been publishing bulletins, and has been quoted in other club bulletins. Certainly there has been no more bitter critic of the ARRL than Clif. Unfortunately for the League just about everything that Clif has been saying has been unarguably true and ARRL has been able to do nothing but fume and hope that he would go away. But since the K6BX-column is still in CQ they must mean someone else.

Between Huntoon's "Dirty Letters" to all ARRL affiliated clubs and Cowan's editorials I thought that groups would be warned not to muscle in on my "take over" of amateur radio.

Plain rot. Does CQ identify this group or anyone in it? You bet they don't. Perhaps you've noticed that when I talk about someone I name names. Cowan, if there is a plot afoot anywhere but in your own imagination, let's have some names. I don't expect any names to be forthcoming for it seems more than likely to me that this about-face in editorial policy at CQ is linked to a desperate attempt to use controversy to arouse some interest in their magazine. I know that advertising has been dropping off badly for them, now reaching about the lowest point in almost ten years. Possibly circulation has done the same? This might explain their sudden move to what looks very much like an abandoned Howard Johnson restaurant out in the sticks (Styx?).

Yes, I read the letters in CQ. Isn't it nice to be so popular that other magazines are talking about you? Most of the writers are quite familiar . . . every field has some like that. The one that I fancied the most was from the Tiny Green Cucumber (WA2TGC). This kid turned up here a week before I took the 73 tour to Europe and was put on trial to see if he could back up his claims of being a top notch technician. Virginia said not to do it, that he was a dope. I gave him a list of things to be done by the time I got back from Europe.

A week after I returned I went up to the mountain and checked to see what the Cucumber had accomplished. I was dumbfounded. In six weeks he had set us back well over six months. I told him I would give him one more week to show some results. He said he guaranteed that he would have us on six meters by the end of the week. That's the last I've ever seen of him. He disappeared that night, complete with Al WA2WIQ. Al's father called a couple nights later and wanted to know where his boy was. I told him that Cuke and Al had scrammed, giving me no notice. He said that he was positive that Cuke had killed his son and that he was going to notify the police. Al, it seemed, had been telling his father about Cuke and there were things I didn't know about him . . . he was dangerous . . . how could I hire someone like that? First I'd heard. Apparently Al turned up alive for I've heard nothing further from his father.

Regarding the six meter antenna: as far as I know this was "appropriated" by K3LNM and is on his car. I'll buy Cuke a new one if

he'll bring our tool supply back to strength on the mountain.

Al, by the way, turned up with a friend of his after I'd left for Europe and wanted to work for 73. No one had authority to hire him while I was gone so he "helped" Cuke up on the mountain. Our Volkswagen station wagon was turned over coming down the mountain by the friend and he skipped out, leaving us with a few hundred dollars in repairs.

It is interesting to read about Cuke working for me . . . he talked with me for just a few minutes during his stay. He knew nothing about me . . . about 73 . . . or about anything else we are doing. His long suits seemed to be sleeping late, drinking coffee and mulling over what was to be done. He makes an excellent witness for CQ, I'd say.

If anyone is really interested in the rest of the crud CQ published they can send a stamped envelope and I'll enclose a complete rundown on the rest of the "Cukes" who wrote in. Ask for Cuke Letter.

Readers of the Autocall and Washington Amateur Radio News, a hate sheet put out specifically to tear the Institute of Amateur Radio apart, may ask for my WARN letter.

Lies?

It has not escaped me that the League has set out to "expose Wayne Green's lies," if I may quote their letter to all affiliated clubs. The letter is an emotional appeal, "misinformation . . . distortions . . . innuendo . . . unfounded rumors" . . . etc.

Please understand the basics before we go to specifics. The fundamental problem is that the Institute of Amateur Radio has been started and this is considered as a threat to the League. Headquarters is not unaware of the deep split that they've driven into the amateur ranks. They are not able to admit their mistake introducing RM-499 and they know that this dissention has simplified the growth of the Institute. Thus they are fighting back at the Institute by personally attacking me and passing off all criticism I may have of the League as lies, distortions, etc.

Now, putting the emotional hysteria aside, we find that the League claims to dispute my report of the Mexico City debacle. I reported that the meeting was held to form Region 2 of the IARU. I reported that the societies balked at this and formed their own organization, which ARRL was allowed to join. The League does not deny this, they avoid

(Turn to page 85)

IoAR News

Don't Take Amateur Radio for Granted

Harry Longerich—W2GQY/4

About the only difference between a rut and a grave are the dimensions! And believe me, we as amateurs have been in a well defined rut for some time. Unfortunately the American amateur, generally speaking, has done very little in taking the initiative to extricate himself from this pleasant rut. He's allowed the "other guy" to make his decisions for him. "Why bother about it; I paid my dues, so why worry?" Then the "other guy" decides he's going to fix this deplorable mess that has crept in among the U. S. amateur fraternity. Wow! The guy in the rut sits up like he's been hit with a bucket of water. He screams bloody murder for a few months and then lies down again, hoping that this will "go away" like the other things which came up in the past—but will it? The pattern is quite clear. Based upon past performance and results these actions "came to be" and we accepted them with some anguish and cries of foul. Are we as American amateurs prepared to continue to accept this pattern from here on in?

Most amateurs don't like to be criticized, even though the criticism is constructive and friendly. Why wait for "someone else" to pass judgment upon you and your hobby? Why not make a critical self appraisal right now and see what the weak points are? This is about the only way you can take the necessary steps to insure that ham radio will remain the wonderful hobby that it is. What can you do as an individual amateur? Plenty! First, find out who represents you in your area. Let him know how you feel and why. Second, start discussions in your local club and bring issues which affect you and your club out in the open. Develop a position which represents the majority feeling. Third, go on record with the appropriate amateur representative of your area so that he knows the "what," "where," "why" and "when" of your club's feelings in the matter. Fourth, take an active part in the over-all affairs which have a direct or indirect bearing upon amateur radio, and last, don't take amateur radio for granted. If you enjoy the many facets of this hobby of ours it's worth quite a bit of your effort and time to insure that you have a voice and say in matters concerning them. You certainly don't let anyone else decide for you in matters which concern your welfare and interests. Or *do* you?

Think about this for a while and if you're the type who doesn't care one iota about the future of amateur radio, then stop reading right here. Congratulations! The chances are that you are really interested in furthering and preserving amateur radio. Also, it's pretty certain that you are already a well informed individual and that you're willing to devote time and energy toward preserving and enhancing amateur radio. "Let's have at it," you say. Fine.

a. Let your voice or the voice of your club be heard through the Institute of Amateur Radio.
b. Become a Founding Member in your area.
c. Have a say in who is elected to represent your views.
d. Know how your money is spent—where, why and by whom.

Why the Institute of Amateur Radio?

- The IoAR represents *you*.
- The IoAR is local, national and international in scope.
- The IoAR represents *all* persons who are, or are interested interested in becoming amateurs and are dedicated to preserving and furthering the art of amateur radio.

Thinking about improving our hobby is good, but don't stop at that. The important thing RIGHT NOW is to take an active and personal part by becoming a Founding Member of the IoAR today. A booklet explaining the IoAR will be sent free upon request to:

L. P. Haslam
W3AYA
14208 Dav Road
Rockville, Maryland

The Institute of Amateur Radio was well represented at the Confederate States Hamfest in June. Left to right are Ed Schaad WA4PDX, Ed Saalis W4UQK, Lloyd Haslam W3AYA, and Harry Longerich W2GQQY/4.

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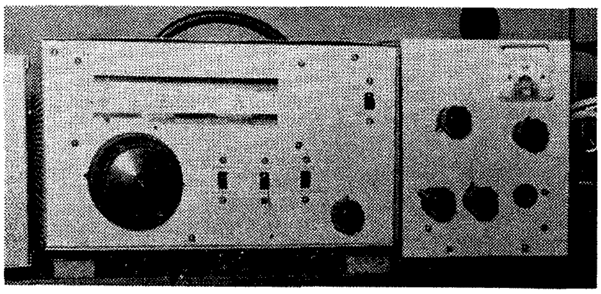
A Two Band Transistor Transmitter

The Transistor has now been developed to such a stage that relative high power can be delivered on the HF bands. It is therefore time to start using these new transistors in transmitter construction instead of tubes. The transmitter, to be described in this article, covers the eighty and twenty meters phone bands, and has an output of approximately one quarter watt. However this power level could easily be raised to 10 watts or more by using newer transistors.

Before going into details with the transmitter, it might be useful to recall that a transistor is not a tube, and consequently is not supposed to act as such. The greatest difference lies in the fact that transistors are power driven devices, whereas tubes are voltage driven devices; this, however is about the only difference one needs to remember when building and adjusting transistorized equipment.

Regarding the description of the transistorized 80 and 20 meter SSB transmitter, transistors offer many advantages over tubes when used in lower power SSB exciters. Heating is no longer a problem and the resulting troubles with frequency drift is eliminated.



Shows the transmitter front view. The knob lower right corner is the band switch. The unit to the right is the linear amplifier.

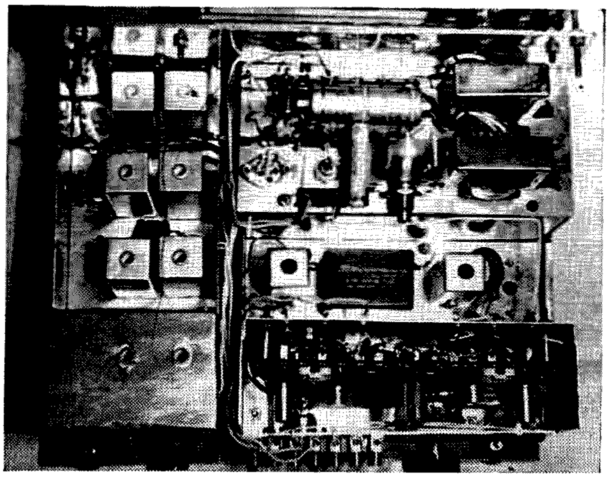
The power drain is much lower, which makes the rig much handier for portable use. The long-time stability of transistors seems to be very good, so a transistorized rig should not call for realignment as frequently as would be necessary in tube rigs. These are only a few of the reasons the author built a transistorized rig.

The block-schematic in Fig. 1 shows the different parts of the transmitter. Carrier is generated on 9 mc, and is fed to a balanced modulator, to which the audio from a 3 stage audio amplifier is also feed. From the modulator the signal—a DSB signal—goes to a 9 mc McCoy crystal filter, where one of the sidebands is cut away. From the filter the signal (which is now a SSB signal) goes to an amplifier and further on to a mixer stage. Into this stage is also injected a signal from a 5 mc oscillator. At the output of the mixer either the sum or the difference signal might be selected (3.8 or 14 mc) and fed to a stage of amplification before going into the final amplifier with an output of approximately 250-300 mw. Although this is not much power, it is sufficient for local contacts, and more than enough to drive the author's linear amplifier well beyond the 300 watts power limit in this country. The rig has an outboard VOX unit identical to the one described by Roy E. Pafenberg in December 1960 issue of 73 Magazine.

The Audio Amplifier

The audio amplifier consists of three transistors. The microphone to be used with this transmitter is a high-Z xtal mike, and since the input impedance of a common emitter stage is rather low, some sort of matching

must be connected between the mike and the amplifier if there is to be no great loss in gain and quality. An input transformer might be used if it is already available, but a far better method would be to use a common collector stage as an impedance match. Such a stage has a very high input impedance, and an output impedance which will match quite well to the following common emitter stage. Between this stage and the output stage there is connected an audio gain control. In the collector circuit of the output transistor there is a driver transformer for a push-pull audio amplifier; only half of the output winding is used to feed the balanced modulator. All coupling- and by-pass capacitors in the audio amplifier have been made quite large, so that a good audio quality (that is, a reasonable amount of bass) can be obtained. The audio amplifier is not a critical part of the transmitter, so it is not necessary to bother with temperature stabilization. The ordinary dc-feedback method shown in schematic will work very well.

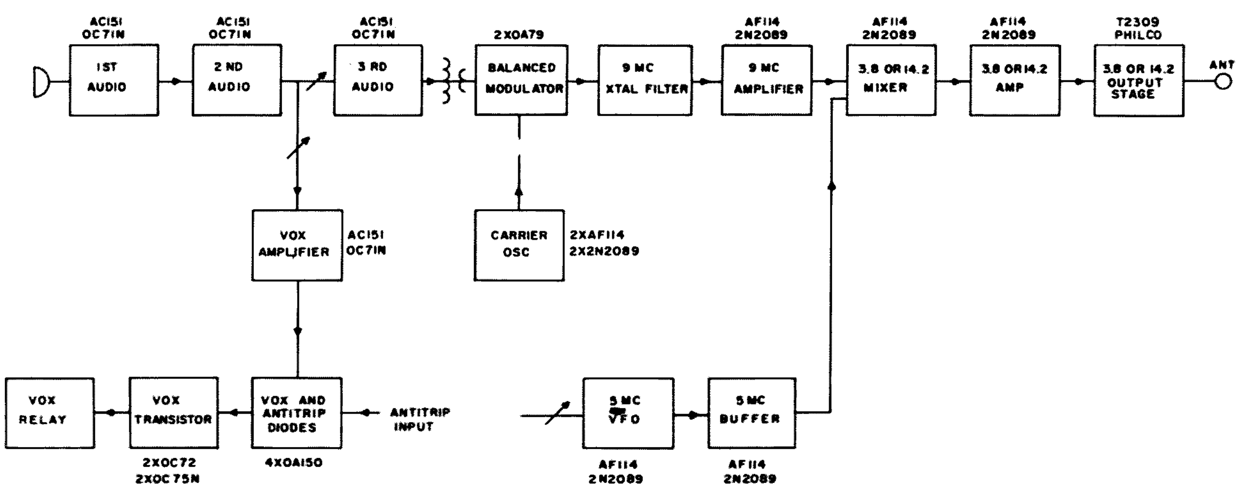


Shows the transmitter from above, to the left are the rf amplifiers, with the mixer near the front panel. To the right are first the power-supply mounted above the oscillator section. Instead of using a 48 volt ct transformer, two 24 volt transformers were connected in series. Next comes the filter section, and below the carrier and audio sections.

The Carrier Oscillator

The carrier is generated on 9 mc., and there is a separate oscillator for each sideband. There are several reasons for the use of two oscillators. The oscillator section had to be mounted in the rear part of the chassis, and it was therefore quite difficult to place a switch in such a manner that it could reach from the rear to the front panel and still leave enough room for other parts of the rig. Another, and probably better reason, is that it is quite difficult to get the crystals to oscillate on the proper frequencies because of the rather high input capacitance between base and emitter. It is therefore necessary not to add any more capacitance to the circuit than needed. The proper sideband is selected by switching the collector voltage to the oscillating transistor. Output is taken from the collector and fed to a broadband transformer wound on a ferrite toroid. The windings are bifilar, and there is no significant resonance in the transformer. Output is fed to the balanced modulator. The crystals are oscillating in a circuit similar to the tube circuit recommended by the McCoy factory, and it should be quite easy to get the oscillators on the proper frequencies by tuning the trimmers. Since these trimmers also control the feedback in the oscillators, it might very well happen that the oscillators have unequal outputs. This can be corrected by adjusting the resistors in the collector supply leads.

TRANSMITTER BLOCK DIAGRAM



The Filter Section

The balanced modulator is of a very conventional design, using two shuntfed diodes. The coil is bifilar wound to assure a good balance. The carrier-nulling is done with a 1 kiloohm carbon potentiometer and a small variable capacitance. The transformer L_2 is a modified 10.7 mc miniature transformer. One of the sections is removed and a bifilar coil L_1 is wound close to the cold-end of L_2. The top of L_2 is coupled to the filter through a 5-30 mmfd capacitor. The filter is shunted by a resistor on 560 ohms to give a proper termination. The coupling network is an L-network, and it is very easy to adjust. The output terminal of the filter is also shunted by a resistor on 560 Ohms, and a tuned circuit with resonance around 9 mc, this resonance is not at all critical, because the coil is shunted with the 560 Ohms resistor. The two shunt resistors are probably not necessary at all, but they help make the tuning very easy. The filter is followed by an amplifier of conventional design, the collector circuit L_4 and L_5 is a standard 10.7 mc transistor *if* transformer. Most types on the marker will easily tune down on 9 mc, but if not they may be padded with an outside capacitor on 10-20 mmfd. There is no impedance match between L_4 and the transistor. It is not needed since the stage delivers gain, but does not add to the selectivity. Signal output to the rf-mixer is taken from the base link L_5 and fed through a piece of coaxial cable.

The Variable Oscillator

The variable 5 mc oscillator is probably the most critical part of the entire rig. If the frequency stability is poor, the exciter is of little value. Luckily, it is rather simple to make the VFO as stable as SSB operation calls for. One big advantage is of course that the transistor does not generate any heat. This almost eliminates all problems with warm-up drift. However, transistors have one fault which might make it difficult to build an oscillator with good long-time stability. This is the rising junction temperature, which is caused by the collector leakage current. The first step towards a stable transistor oscillator must therefore be to make a good DC stabilization. DC stabilization is also necessary because a changing collector current will cause a change in the transistor's load impedance and load capacitance. All capacitors must be of the best quality; as in a normal tube oscillator, silver mica capacitors and air trimmers must be used. Needless to say, all components must be rigidly mounted. The oscillator which tunes 5.1-5.35 mc, is followed by a buffer stage. With the coverage listed the exciter will tune 3.9-3.65 mc and 14.1-14.35 mc. The buffer stage is a must if good stability is to be obtained. This stage is a normal common emitter, and no trace of frequency shift was noted under modulation. The voltage for the oscillator and the buffer stage should be stabilized by a zener diode or powered from a separate battery, to eliminate pulling when the rig is used as a mobile exciter.

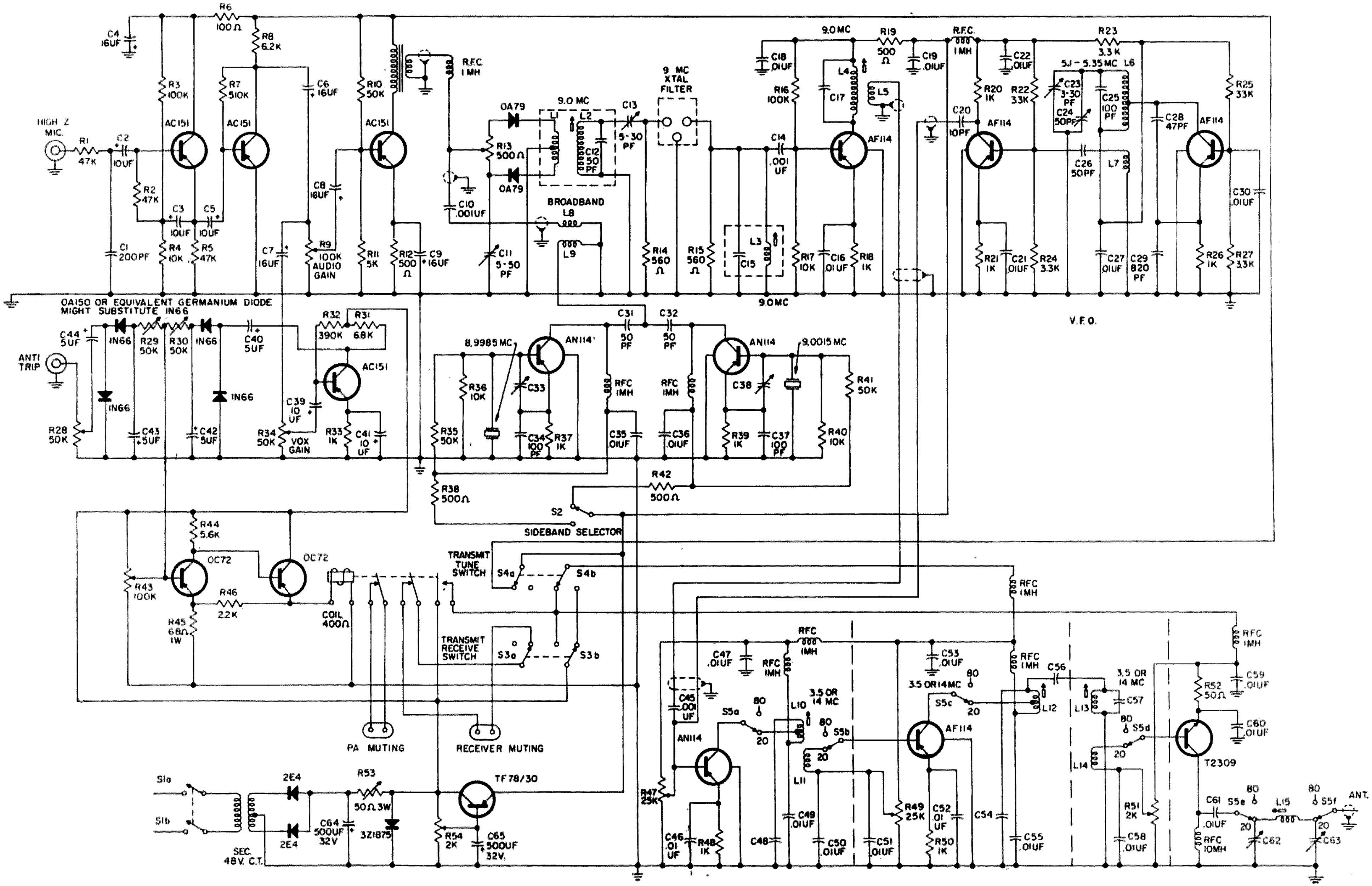
The RF Amplifiers

The rf mixer is a normal additive mixer stage. No attempt has been made to try a balanced mixer, since the mixer is followed by so many tuned circuits that there have been no troubles with any type of spurious radiation from the rig. The base circuit of the mixer should be well shielded, so that there is no possibility of rf pick-up from the linear amplifiers. Remember that the power level at this point is very low and not much rf is needed to make a feed-back chain. The proper base bias is selected with a small "set and forget" potentiometer. In the collector circuit there is a tuned circuit for 20 and 80 meters. The collector is tapped down on the coil L_{10} to give a good match, so that ample gain and selectivity can be obtained.

The mixer is followed by a common emitter rf amplifier stage. The rf signal is fed to the amplifier via a link L_{11} wound on the cold-end of L_{10}. One side of the link is bypassed to ground, both in the mixer and in the amplifier section. This is necessary to prevent self-oscillation and pick-up. The collector is tapped in on the collector coil L_{12} so as much gain as possible can be obtained. The coupling to the output stage is done through a band-pass filter. This band-pass filter is necessary to assure a good unwanted signal sup-

Notes on diagram

C33 and C38 both 4-30. Adjust C33 and C38 to correct carrier frequency and R38 and R42 for the same output on both sidebands.
Adjust R53 so the no-load zener current is approx. 125 ma.
Adjust R54 so the emitter voltage under load is 9 volts.
* Indicates silver-mica capacitors.
L2, L3 and L4 are standard 10.7 mc transformers.
C12, C15 and C17 are selected so the circuit will resonate on 9 mc.
L1 2x5 turns bifilar wound on cold-end of L2, L5 3 turns on cold end of L4.
Unmarked capacitors are mmfd. N means x1000.



HIGH Z MIC.
R1 47K
C2 10UF
C1 200PF
R2 47K
R3 100K
R4 10K
R5 47K
C3 10UF
C5 10UF
C4 16UF
R6 100Ω
R7 510K
R8 6.2K
C6 16UF
C7 16UF
C8 16UF
R9 100K AUDIO GAIN
R10 50K
R11 5K
R12 500Ω
C9 16UF
AC151
R.F.C. 1MH
C10 .001UF
C11 5-50 PF
R13 500Ω
0A79
9.0 MC
L1
L2
C12 50 PF
C13 5-30 PF
BROADBAND L8
L9
9 MC XTAL FILTER
R14 560Ω
R15 560Ω
C15
L3
9.0MC
C14 .001 UF
R16 100K
C18 .01UF
R17 10K
C16 .01UF
R18 1K
C17
L4
L5
AF114
R19 500Ω
C19 .01UF
R.F.C. 1MH
C20 10PF
R20 1K
R21 1K
C21 .01UF
C22 .01UF
R22 33K
R23 3.3K
R24 3.3K
5.1 - 5.35MC L6
C23 3-30 PF
C24 50PF
C25 100 PF
C26 50PF
L7
C27 .01UF
C29 820 PF
C28 47PF
R25 33K
R26 1K
R27 33K
C30 .01UF
V.F.O.
0A150 OR EQUIVALENT GERMANIUM DIODE MIGHT SUBSTITUTE IN66
C44 5UF
ANTI TRIP
IN66
R28 50K
R29 50K
R30 50K
C43 5UF
C42 5UF
C40 5UF
R32 390K
R31 68K
C39 10 UF
R34 50K VOX GAIN
R33 1K
C41 10 UF
8.9985 MC
AN114'
R36 10K
C33
R35 50K
C34 100 PF
R37 1K
C31 50 PF
C32 50 PF
RFC 1MH
C35 .01UF
C36 .01UF
AN114
9.0015 MC
C38
R39 1K
C37 100 PF
R41 50K
R40 10K
R38 500Ω
R42 500Ω
S2
SIDEBAND SELECTOR
R44 5.6K
OC72
R43 100K
R46 2.2K
R45 68Ω 1W
COIL 400Ω
TRANSMIT TUNE SWITCH
S4a
S4b
TRANSMIT RECEIVE SWITCH
S3a
S3b
PA MUTING
RECEIVER MUTING
S1a
S1b
SEC. 48V. C.T.
2E4
C64 500UF 32V
R53 50Ω 3W
3Z1875
R54 2K
TF78/30
C65 500UF 32V.
RFC 1MH
C47 .01UF
C45 .001 UF
S5a
80
20
3.5 OR 14 MC
L10
L11
S5b
R47 25K
C46 .01 UF
R48 1K
C48
C49 .01UF
C50 .01UF
C51 .01UF
C53 .01UF
3.5 OR 14MC
S5c
AF114
R49 25K
C52 .01 UF
R50 1K
C54
C55 .01UF
C56
L12
L13
C57
S5d
L14
R51 2K
C58 .01UF
R52 50Ω
C59 .01UF
C60 .01UF
T2309
C61 .01UF
S5e
L15
S5f
ANT.
RFC 10MH
C62
C63

pression. In contrast to voltage-driven tubes, transistors may cause loading because they are power-driven. The selectivity is therefore much lower in a transistorized circuit than in a tube circuit. Consequently more tuned circuits are needed in a transistor rig to obtain a certain degree of selectivity than would be necessary in a tube circuit. Drive for the output transistor is taken from a small link L_{14} on the cold-end of the last coil L_{13} in the band-pass filter, and fed to the base of the transistor. This stage is also connected as a common emitter stage. The output circuit is a pi-network since it was the easiest to use. Impedance matching from the collector to the tuned circuit and further on to the antenna must be correct. If not, the stage will deliver a very distorted signal to the antenna. The author has had little success in calculating the proper values for the pi-network, so the values used were obtained by trial and error. In all but the last stage, the value of the base voltage divider or potentiometer is relatively uncritical, although lower resistance gives better stability. But in the final stage the potentiometer should not have greater than 2 kilohm resistance, or it would be difficult to get the stage to work as a linear amplifier. This is simply because the linear draws base current, and when used as a power amplifier, the change in base current is quite high. If the resistance in the circuit now is high, this will cause a great swing in base bias, resulting in distortion. By keeping the resistance low, a greater change in current can be allowed, without affecting the base bias. Remember that transistors are power driven, and will therefore draw base current when operating in class A, B and C.

As noted in the schematic, there is no tuning controls but the VFO. This is because it is possible to tune the rf amplifiers in such a manner that uniform gain is obtained in a band-pass of around 100 kc on 80 meters and around 400 kc on 20 meters, measured on a dummy load. Outside of the band-pass the gain drops off rapidly. This rig is tuned with a center frequency on 3750 kcs and 14175 kcs, and can cover 3.7 to 3.8 mcs and 14.1 to 14.35 mcs. The main SSB band in Europe is 3.7 to 3.8 mcs, but the transmitter can easily be tuned in the American phone band. However, only the range 3.8 to 3.9 mcs may be covered, without changing the values of the oscillator components. The output transistor, a Philco T 2309, delivers around 250 to 300 mw's output.

The Transistors

Little has been said about the transistors used in the transmitter; the reason is simply that the transistors the author used, might be difficult to obtain in the USA since they are made in Europe by Siemens. Furthermore it is quite difficult to find usable equivalent transistors, as may be seen from the variety of types in the Philco, Texas and PSI catalogues. Some data on the type of transistors used might help in selecting proper substitutes (See table I).

All germanium PNP types. OA 79 and OA 150 are rf germanium diodes with high back resistance. Almost any two matched diodes will do in the balanced modulator.

The VOX

It is not necessary to say much about the VOX circuit, since it has already been well covered in an earlier issue of this magazine. However, it might be necessary to mention the fact that the supply voltage to the VOX and audio stages must be quite stable in order to avoid troubles with self triggering. The first power supply used in this transmitter had a voltage drop of about 0.5 volt when the transmitter was activated. This voltage drop looked like a "one shot pulse" to the audio amplifier, and was amplified enough to be able to trigger the VOX stage. The pulse frequency was around 1 c/s., so this kind of trouble might be prevented by using a small coupling capacitor between the audio amplifier and the VOX amplifier, or by stabilizing the supply voltage. In fact, since the voltage for the oscillators must be stabilized, it is no extra trouble to stabilize the entire power supply.

Table 1

						Suggested Replacement
AC 151	audio trans .	col diss. 30 mw	h_{fe} 60 —	V_{cbo} 18 V. —	OC71N —	Amperex
AF 114	VHF trans .	col diss. 50 mw	h_{fe} 15 0—	V_{cbo} 20 V.	2N2671 —	Amperex
OC 72	audio trans .	col diss. 100 mw	h_{fe} 75 —	V_{cbo} 32 V. —	OC75N —	Amperex
TF 78/30	audio trans .	col diss. 3 W	h_{fe} 50 —	W_{cbo} 30 V. —	2N178 — or 2N176	Motorola

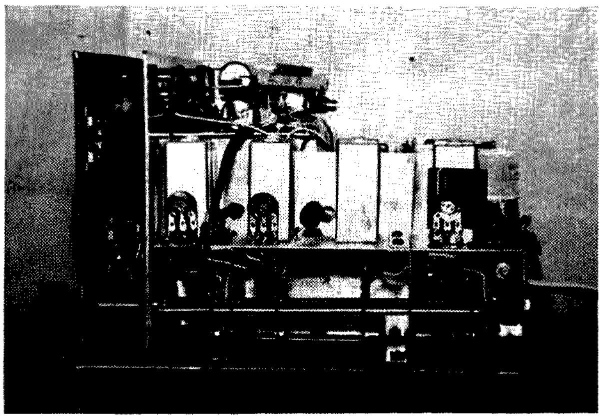
Mechanical Layout

Although it was decided to etch all circuitry, it was soon found that this type of mounting was excellent for making a neat and clean-looking construction, but not very useful when components had to be removed or changed. Instead, the rig was made by placing the different stages in small sub-chassis. This proved to be very useful when testing the different stages. The entire exciter measures approximately 6 by 9 by 11 inches. Although it is not a miniaturized rig, it could easily be made much smaller without affecting anything but the dial. A good and stable exciter is not worth much if you don't have a dial which can tell you your exact frequency, so the dial will determine how small the rig might be. The variable oscillator and the rf amplifiers should be carefully shielded to prevent pick-up and self-oscillation. All coils are housed in cans. The photos show how the different stages have been placed.

The Alignment

The alignment of the exciter begins with the power supply. First, adjust R_{53} so the no-load zener current is approximately 125 mA. Next, the transmitter is connected to the power supply. Be sure that the potentiometers R_{47} and R_{49} are set with the arm to the ground side, and R_{51} set with the arm to the negative side. Switch S_3 and S_4 to transmit, and adjust R_{54} so the voltage on the low-voltage line is around 10 volts. Later, when all amplifiers have been adjusted correctly, the control is readjusted so that the voltage is 9 volts. Now disconnect all stages but the audioamplifiers. All 3 stages should draw 3-4 ma at 9 volts. Connect a high-Z mike to the input and a pair of phones over the output terminals of the audio transformer with the balanced modulator disconnected. Speak into the mike and check for a good audio quality. If an audio generator and a VTVM is available then check the response. Be sure to have sufficient bass; the drop-off should be around 200 to 300 c/s., but not higher. The output with the gain control full clockwise should be at least 0.5 volt across a 500 ohm load.

The next stage to be checked is the VOX. First, apply collector voltage to the stages; next, adjust R_{43} so the relay just goes in the receiving position (great voltage drop across the relay coil). You will find the adjustment of the VOX balance (R_{43}) quite critical; set the potentiometers as near to the switch position as possible. Now advance the VOX



Looks into the rf amplifier section, note the heat-sink on the output transistor made of a piece of tinned iron bent around the transistor.

gain (R_{34}) while speaking into the mike. If nothing is wrong the VOX relay will start to trigger. The delay might be adjusted slightly with the R_{30} and R_{43} potentiometers. Adjust the controls until a desired VOX operation is obtained. Under normal VOX operation the switch S_3 should be in the receiving position.

Now connect the two carrier oscillators in the circuit and connect a VTVM from the hot-end of L_9 to ground; check to make sure that both oscillators are oscillating. Place both trimmers C_{33} and C_{38} at full mesh. If a frequency meter or an accurate receiver on 9 mc is available, the correct positions of the carrier oscillators might be fixed with C_{33} and C_{38}. If these facilities are not available, the carrier oscillator will be fixed later when the rig is on the air in a ham band. Also adjust R_{38} and R_{42} so the two oscillators are giving the same output. Note! (this should not be done until the carriers are placed in correct relation to the filter).

If a high sensitive VTVM is not available, which is not likely to be the case in an amateur station, the next step will be to test and adjust the variable oscillator. Connect the oscillator and the buffer to the 9 volt line. If the oscillator is oscillating properly there should be around 2-4 volts of rf on the collector of the buffer transistor. Make sure that the oscillator is covering the desired range with a grid-dip meter or a receiver. As an example tune the oscillator so that the output frequency of the exciter will be 3.8 mc. The oscillator will then be on 5.2 mc. Switch the bandswitch to the eighty-meter position. Resonate with a grid-dipper or a transistor-dipper L_3 and L_4 to 9 mc, and adjust L_{10}-L_{12} and L_{13} to 3.8 mc. Set the collector current of the rf mixer to approximately 4 ma by R_{47}. Connect the receiver through a small

capacitor to the hot-end of L_{11} and tune to 3.8 mc. Start to speak into the mike, and tune the receiver back and forth until you can hear the transmitter. Then adjust L_2 and C_{13} and readjust L_3 and L_4 for maximum signal and best quality. Adjust R_{13} and C_{11} for carrier null, and try to move C_{11} to the other side of the balance control if no result is obtained in carrier nulling. Adjust C_{33} for the proper sideband position, switch to the other sideband, and repeat the treatment with C_{38}. Readjust the carrier balance controls for maximum suppression on both sidebands. The setting of L_2 and C_{13} might affect the carrier balance, so adjust these once more.

Having come this far, you are pretty well on the way. Disconnect the receiver from L_{11}, and place a VTVM on the collector of the mixer. Peak the core to maximum output; also adjust R_{47} to maximum output (the adjustment of R_{47} might be more critical on twenty than on eighty meters). The rf voltage on the mixer collector should be 0.5 to 1.5 volts. Now connect the remaining amplifiers to the 18 volt line and a 50 ohm dummy load across the antenna terminal. Place a milliameter in series with the emitter of the T 2309. Place the VTVM from the hot-end of L_{14} and adjust L_{12}-L_{13} and R_{49} for maximum deflection on the meter (approximately 2-3 volts). Move the VTVM across the dummy load and connect also the receiver through a small capacitor to this dummy load. Listen to the receiver while slowly advancing the bias control R_{51}. At a certain setting the signal will change from highly distorted to a clear signal. Note the idler current (approximately 20 ma), and adjust $C_{62\text{-}63}$ and L_{15} for maximum output. The position of R_{51} will be found to be quite critical. You have now almost completed half of the tuning procedure; the only remaining thing to be done is to retune the rf amplifiers so it covers the desired range with a uniform output.

Repeat the entire procedure outlined above on 20 meters. The bias potentiometers should also be readjusted since they might be a little more critical on this band than on 80 meters. There should be no trouble in getting the exciter to cover the entire twenty meter band. If the shielding is good, there should be no trouble with parasitic or self oscillation.

Although the exciter has been designed for fixed use, it could very easily be modified for mobile use. Changing the 18 volt line to 12 volt should not affect the operation, but will of course give a somewhat lower output. To avoid frequency changing and drift in operation while driving, the oscillators should be fed from a dry battery or a pair of cascade coupled zenerdiodes.

The transmitter has now been in use for about one year and has shown very good operation facilities. The low power drain enables the rig to be tuned on at all times, so the frequency stability can be even better. The author got the rather bad idea of placing the power supply on top of the oscillator section. And since the transformer generates some heat, this heating could affect the frequency stability. By leaving the power on at all times, the temperature will be kept rather constant, thus eliminating the warm-up drift. However, the power drain is below 5 watts, so you don't have to bother about the electric bill.

. . . OZ7BQ

COIL DATA

L_1 4 + 4 turns bifilar wound on cold end of L_2.
L_2 one section of a standard 10, 7 mc if transformer.
L_3 same as L_2
L_4 same as L_2, L_5 base winding.
L_6 16 turns Airdux 816, collector taped 8 turns from the hot end.
L_7 3 turns on the cold end of L_6, spaced 2 turns.
L_9,L_8 broad-band transformer wound on a ferrite toroid L_9 12 turns, L_8 3 turns.
L_{10} 80 meters: 20 turns, taped 5 from hot end.
20 meters: 14 turns, taped 5 from hot end.
L_{11} 80 meters: 4 turns.
20 meters: 3,5 turns.
L_{12} as L_{10} on both bands.
L_{13} as L_{10} but no taping.
L_{14} 80 meters: 4 turns.
20 meters: 2,5 turns.
L_{15} 80 meters: 25 turns.
20 meters: 10,5 turns.
All coils are wound on a 8 mm form = 5/16", close-wound with number 20 wire. The cores are all high permeability ferrite cores.

CAPACITANCE VALUES

C_{48}	80	meters	350	mmfd	20	meters	90	mmfd
C_{54}	80	meters	350	mmfd	20	meters	90	mmfd
C_{56}	80	meters	50	mmfd	20	meters	15	mmfd
C_{57}	80	meters	350	mmfd	20	meters	90	mmfd
C_{62}	80	meters	1000	mmfd	20	meters	250	mmfd
C_{63}	80	meters	3000	mmfd	20	meters	750	mmfd

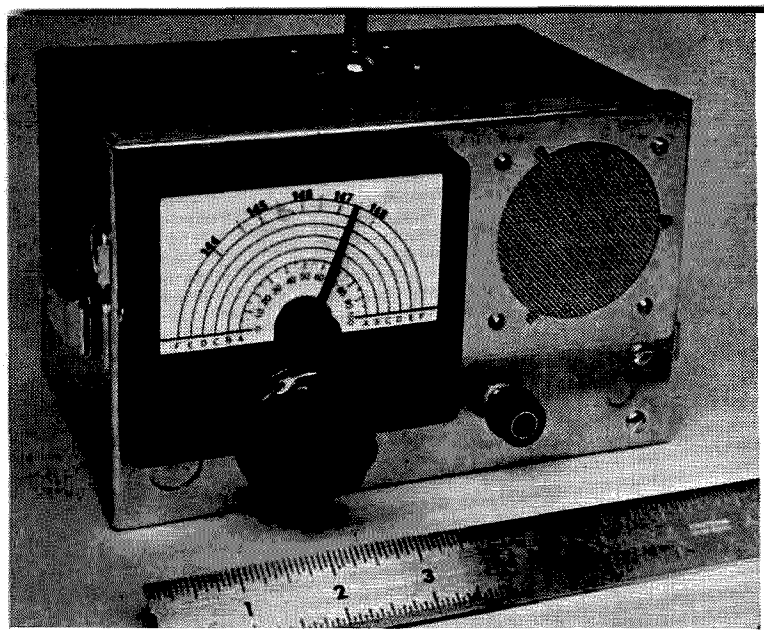
Letter

Dear Wayne:

Regarding my "Armstrong Sweeper" (April 73), it appears that it is not as obvious as I thought that one must use a scope with D.C. coupled horizontal input. Perhaps it might be wise to mention this in the Parts kit description.

A simple remedy for those who have an A.C. coupled horizontal amplifier might be to use the deflection plates directly, if they are available (D.C. coupled, of course, with no high voltage!). This naturally means increasing the supply voltage to the sweep pot. 100 volts seems to be a good choice, since it will dissipate 1 watt in the sweep pot and provide a reasonable deflection on a CRT with a sensitivity of 20 to 40 volts per inch. For less sensitive tubes the voltage must be increased accordingly. The sweep pot must also be changed to a higher value.

Albert E. Donkin, W2EMF



Walt Pollind K6TOV
5661 Elinora Lane
Cypress, Calif.

Two Meter Transistor Receiver

If you like to travel light, here is a compact, all transistor, 2 meter receiver that can be used fixed, portable, or mobile. The receiver uses 9 transistors: rf, mixer, oscillator, 3 *if* stages, a driver and class B output amplifier. Frequency coverage is 143 mc to 150 mc. *If* frequency is 10 mc and the overall 3 db bandwidth of the *if* amplifier is 50 kc. The receiver operates on 12 volts and total current drain is 20 ma, which makes it ideal for portable operation.

Since the receiver operates on 12 volts, it can be readily adapted for mobile use. For fixed operation, batteries or a separate power supply could be used. I am using 3, 4 volt Mallory Tr-133R, mercury batteries in series. The unit is housed in a box 7⅛″ × 4½″ × 4 11/16″ deep.

Performance

The receiver has good sensitivity across the entire band, approximately 1 micro-volt. Selectivity is good since careful attention was given to matching in the rf and *if* stages. The receiver has a noise figure of approximately 3 to 4 db.

I have compared the receiver with a good converter and communications receiver and it really holds its own and better.

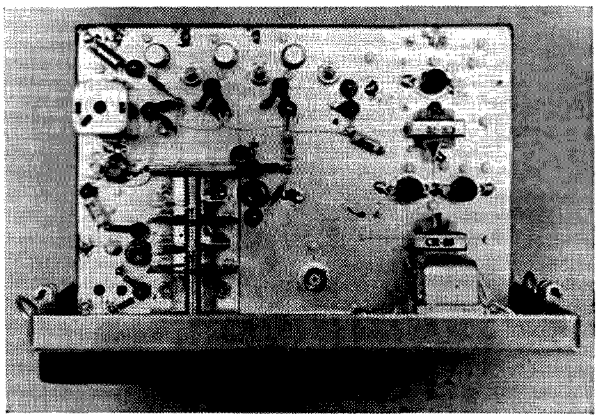
About The Circuit

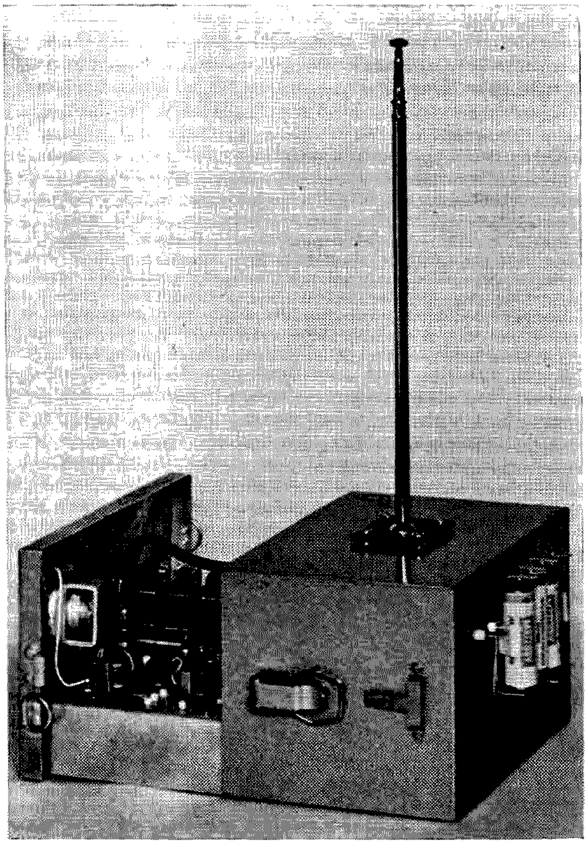
The rf amplifier is a common emitter stage, using a PNP Sprague 2N1742 or Amperex 2N2495 transistor. This transistor was designed for operation in the frequency range of 30 to 800 mc, and is capable of 20 db of gain at 150 mc. The rf stage is not tracked but is peaked up at the center of the band, 146 mc. Only the mixer and oscillator are tracked.

The 2N1742 or 2N2495 is also used in the common base oscillator. Feed-back is furnished by capacitor C 39 from collector to emitter. The oscillator is tuned below the incoming signal.

The mixer transistor is a Sprague PNP 2N-1743 or Amperex 2N2084 designed for mixer operation in VHF applications. A series trap is connected to the base of the mixer to insure a low impedance at the *if* frequency. The use of the trap improves image rejection. Capacitor C 8 and a 3.3 micro-henry choke make up the series trap. Base injection is used in the mixer.

The *if* amplifier uses 3 (RCA) PNP 2N1180





transistors; all 3 stages are connected as common emitter amplifiers. The first and second *if* stages are neutralized. Gain of approximately 18 to 19 db per stage is obtained at 10 mc. AGC is applied to the first *if* amplifier, Q 4.

If desired, an rf gain control can easily be added (see Fig. 3).

Construction

Front panel dimensions are 7 5/16″ × 4⅝″. Components are mounted on a cadmium plated brass chassis, 6¾″ × 4⅝″ × 1½″. Thin brass material was used for shielding and in the rf and *if* stages the shields were soldered in place. If an aluminum chassis is used, shields and ground lugs can be secured with hardware. Solder-type capacity feed-thrus were used in the unit, however, the threaded type may be used if desired. For stand-offs and feed-thrus, the small teflon type were used.

Construction can begin with the front end. The tuning capacitor, C 4, is a 3 gang variable, only 2 sections being used. Remove all but 2 plates from each section, one rotor and stator remaining per section. A dual section variable can be used for C 4 if desired.

Mount the tuning capacitor, C 4, approximately as shown in Fig. 1. Next the rf and oscillator sockets, (Elco no. 3307), should be located as close as possible to the tuning capacitor, C 4, (see Fig. 1). The rf and oscillator transistor sockets, (Elco no. 3307), are the 4 pin type, since the Philco T-2028 has 4 leads: base, emitter, collector and shield.

Capacity feed-thrus, C 22, C 23, C 38, C 41, are located as shown in Fig. 1. The emitter bypass, C 6, is a stand-off feed-thru type capacitor; the button type or a capacitor feed-thru can be used. C 6 should be located close to the emitter lead of Q 1.

Before mounting L 1, solder a 1 inch length of number 22 bus wire, ½ turn up from the cold end of L 1. This will be the antenna tap. Solder another 1 inch lead 1 turn up from the cold end; this tap goes to the base of Q 1. L 1 can be secured in place by soldering the cold end directly to the capacity feed-thru C 22. Solder C 2 and C 3 across L 1. The shield for Q 1 can then be secured in place. The cold end of L 2 is soldered to C 23; the other

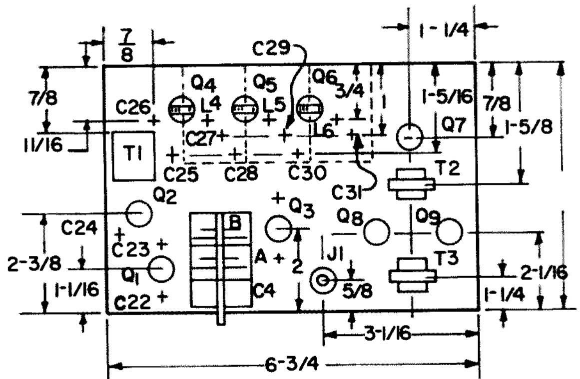


FIG. 1

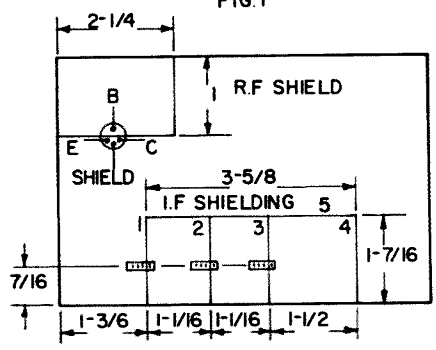


FIG. 2

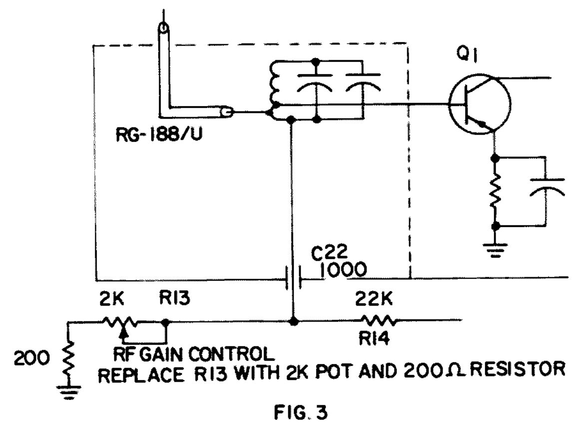
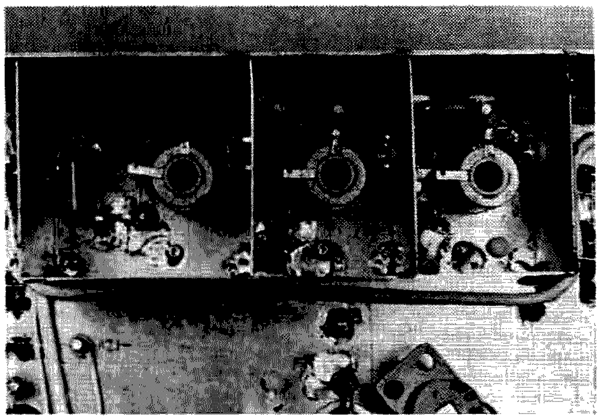


FIG. 3



end to the collector lead of Q 1. Then run a lead from the collector of Q 1 to C 4A. Keep lead lengths short.

Oscillator coil L 3 is secured in place the same as L 2. The cold end is soldered to C 41, again keeping lead length short. The 3-12 mmfd trimmer capacitors can be located as shown or mounted on the tuning capacitor C 4. The mixer is located close to L 2 so that lead length for coupling capacitor C 7 can be kept short.

Mount the *if* transformer, T 1, as shown in Fig. 1. Locate the *if* transistor sockets (Elco no. 803-BC) and capacity feed-thrus. Before mounting the shields across the sockets (Fig. 2) install the 2 feed-thrus that connect the neutralizing capacitors, C 11 and C 15. *If* coils L 4, L 5, and L 6 are installed last. Leave the side shield off until you have completed wiring the *if*.

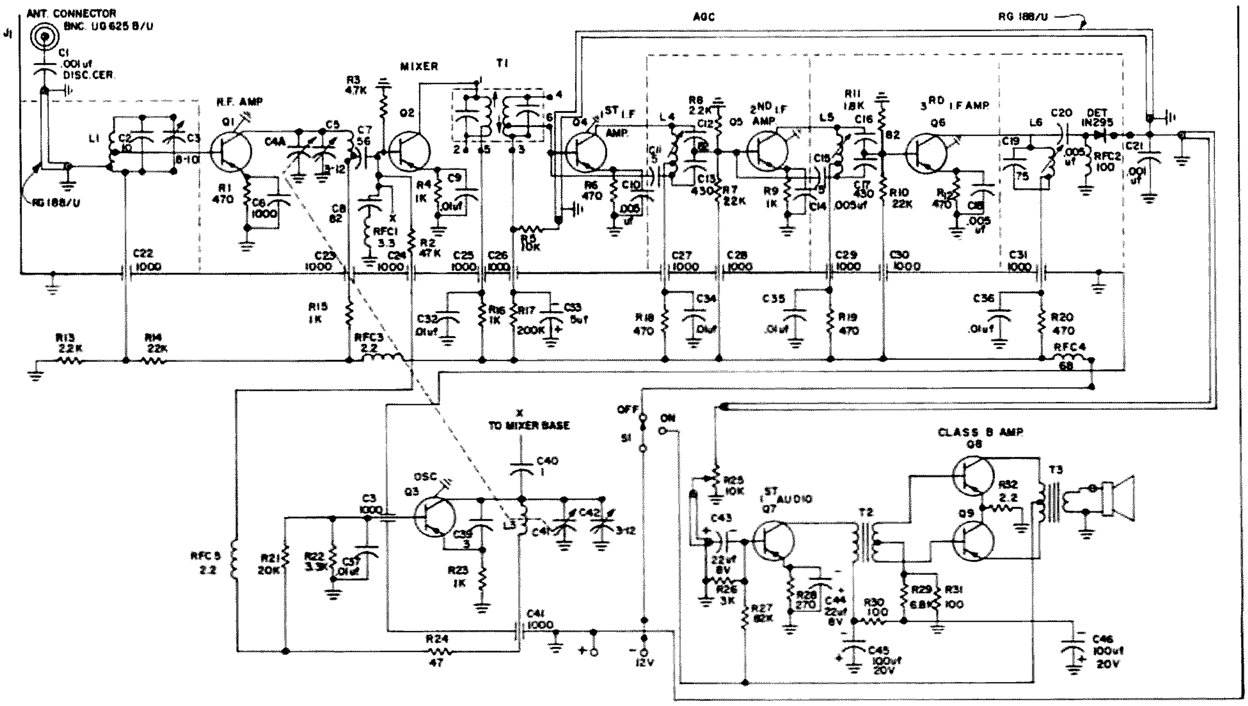
Last but not least, the audio section can be located approximately as shown in Fig. 1. Transistor sockets used for the mixer and audio section are Elco no. 3301.

Tuning Up

The rf amplifier is adjusted first. Install transistor Q 1; with voltage applied and tuning capacitor C 4 fully open, couple the grid dip meter near L 2; adjust trimmer capacitor C 5 for a dip at 150 mc; close C 4 and adjust L 2 by squeezing or spreading the turns for a dip at 143 mc. If after doing this several times, you find difficulty in covering the tuning range at the high end, the rotor plate, C 4A, may be bent out slightly, reducing capacity.

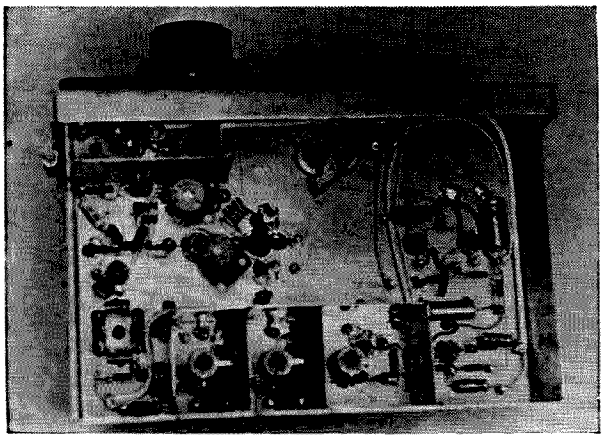
The rf amplifier can be adjusted with a signal generator and rf voltmeter. Connect the generator to antenna connector J 1; connect the rf probe to the base of mixer Q 2, and using the same procedure as above adjust for a peak at the high and low end.

Next install oscillator transistor Q 3. With voltage applied, tuning capacitor C 4 fully open, with the grid dip meter in the diode position and loosely coupled near L 3, adjust trimmer capacitor C 42 for a peak on the grid dip meter at 140 mc; close C 4 and adjust L 3 for a peak at 133 mc.



Note: Philco is still manufacturing their VHF transistors. The new number for T-2028 is 2N2398 and the 2N1743 is now the 2N2361. Th eSprague 2N1743 will do just fine for the mixer. The 2N2398 will do a little better than the PNP 2N1742 or 2N2495 for the rf amp and osc.

All capacitors mmfd unless marked. All resistors in ohms, ¼W unless marked. All inductors in microhenries unless marked.



The *if* amplifier is peaked up with a signal generator at 10 mc. Connect the generator to the base of the mixer, Q 2, through a 10 mmfd capacitor. With the generator in the rf modulated position, peak up T 1, L 4, L 5, and L 6 for maximum signal at speaker. L 1 can be peaked up on a signal at 146 mc by adjusting trimmer capacitor, C 3, .8-10 mmfd.

Take your time and make it neat, I know you will be pleased with the results. Compare the receiver with other equipment and I know you will agree that transistors have their place in VHF. Good dx-ing.

. . . K6TOV

PARTS LIST

Capacitors
C 1, C 21—.001 mfd-disc. cer.-50V
C 2—10 mmfd-dura-mica El-Menco
C 3—.8-10 mmfd—trimmer—Johnson or JFD
C 4—tuning capacitor—see text
C 5, C 42—3—12 mmfd—trimmer—Erie
C 6—1000 mmfd—Stand off capacitor—see text
C 7—56 mmfd—dura mica—El Menco
C 8, C 12, C 16—82 mmfd—dura mica—El Menco
C 9, C 32, C 34, C 35, C 36, C 37—.01 mfd disc. cer. 50 V
C 10, C 14, C 18, C 20—.005 mfd—disc. cer. 50 V
C 11, C 15—5 mmfd—dura mica—El Menco
C 13, C 17—430 mmfd—dura mica—El Menco
C 19—75 mmfd—dura mica—El Menco
C 22, C 23, C 24, C 25, C 26, C 27, C 28, C 29, C 30, C 31, C 38, C 41—1000 mmfd—feed thru capacitor—see text
C 33—5 mfd 12 volt
C 39—3 mmfd—dura mica—El Menco
C 40—1 mmfd—dura mica—El Menco
C 43, C 44—28 mfd 8 volts
C 45, C 46—100 mfd 20 volts
RFC—1—3.3 micro-henry
RFC—2—100 micro-henry
RFC—3, 5—2.2 micro-henry
RFC—4—68 micro-henry
S1—part of R 25, 10K pot—Calrad
J1—Ant. connector—BNC—UG 625 B/U
T2—driver Xmfr—10,000 ohms to 2000 ohms C.T.—Calrad CR-70
T3—output Xmfr 500 ohms C.T. to 3.2 ohms—Calrad CR-80
Transistor Sockets—see text
Dial—Millen-type 10039
Transistors
Q 1—RF amp. (Sprague PNP 2N1472) or Amperex 2N2495
Q2—mixer (Sprague PNP 2N1743) or Amperex 2N2084
Q 3—Osc. (Sprague PNP 2N1472) or Amperex 2N2495
Q 4, Q 5, Q 6—*If* amp. RCA PNP 2N1180
Q 7, Q 8, Q 9—Audio amp. RCA PNP 2N270
Coil Table
L 1—5 turns no. 18 solid 3/16" dia. Antenna tap, up ½ turn from cold end. Base tap, up 1 turn from cold end.
L 2—3 turns no. 18 solid ¼" dia. tapped up ½ turn from cold end.
L 3—4 turns no. 18 solid
L 4, L 5, L 6—26 turns no. 28 enamel covered wire wound on Cambion PLS-6 coil form ¼" dia. red slug tap up 3 turns from bottom end Cambion coil form Cambridge Thermionic Corp.
T 1—transistor *if* Xmfr No. 1601 (J. W. Miller Co.)

Stripping Transistor Radios

John Walters K8YCH
1328 E. 26th Ave.
Columbus, Ohio

A trip to your local transistor radio dealer will turn up a bunch of two transistor radios that do not work. At their selling price ($4 to $6) the dealer cannot spend much time trying to repair them. So he will probably be more than glad to sell them cheap. I picked up eleven for seventy cents per radio. There is a lot of variation in the circuit of these radios, but most of them use one stage of rf, reflexed rf-af, then one stage of audio. Of the eleven radios I picked up, six of them had simple troubles. Bad switch, open ear phone jack, break in the board, open wire on battery plug, etc. The other five had an open reflex coil, a broken variable capacitor, a bad transistor, or a broken board. By stripping the parts out of these, I found I had out of each radio: two transistors (one that was good at least 1600 kc and one audio type), one driver transformer, one output transformer, one speaker, two to four electrolytic capacitors, two to four ceramic or paper capacitors, three to six fixed resistors, one variable capacitor, and one variable resistor with switch (most of these were 5000 ohms), one loop stick antenna, one reflex coil, one case, and miscellaneous hardware. By using the parts of these radios you can make the following:

1. *A code osc.* (See Fig. 1.) The setting of the pot will determine the frequency of osc.; also, the value of the capacitor will affect it. Somewhere in the range of the pot it will oscillate. If it won't, reverse the winding on the secondary of the transformer.

2. *A speaker mike.* (See Fig. 2.) The value of R is such that ½ the supply voltage will

be dropped across the load resistor. Use the radio with a 3 or 3½" speaker for best results.

3. *An rf oscillator or bfo.* (See Fig 3.) By using this as a test oscillator I fixed some of the other radios. The value of R will change the wave shape. Too low a value will give a very peaked wave, while a high value will give a square wave. Somewhere in between 50 and 100 K ohms you should get a nice sine wave. By putting posts on the points marked X you can make an rf transistor checker. By putting the right value of condenser in parallel with the variable, you have a bfo. This has been used with a no name type short wave receiver for code practicing. I have used one of the 3" speakers on my receiver.

These are only three applications. There are many more. I'm working on an intercom and also a phone patch. In this day and age of high prices it sure is nice to be able to build and play around cheap. As for the radios that did work, my wife, my son, and my in-laws all have one. I have traded one for a coaxial relay and I still have some for trading purposes.

So go to it. You can't lose much money, you might make some. You'll learn more about transistors, and you might have some mighty cheap Xmas presents for some boy or girl.

Any other applications you might come up with let me know!

. . . K8YCH

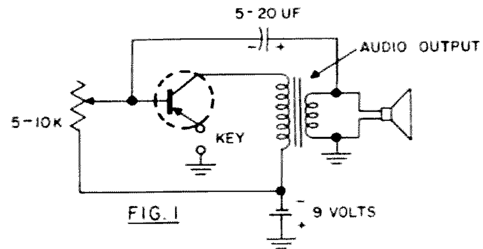


FIG. 1

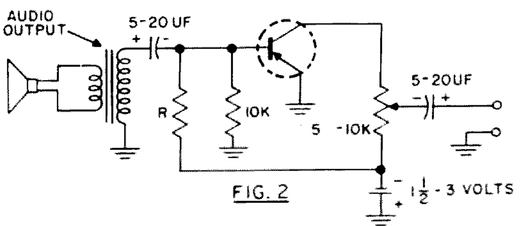


FIG. 2

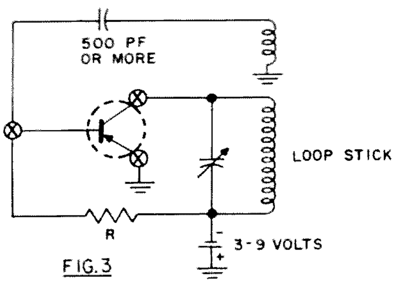
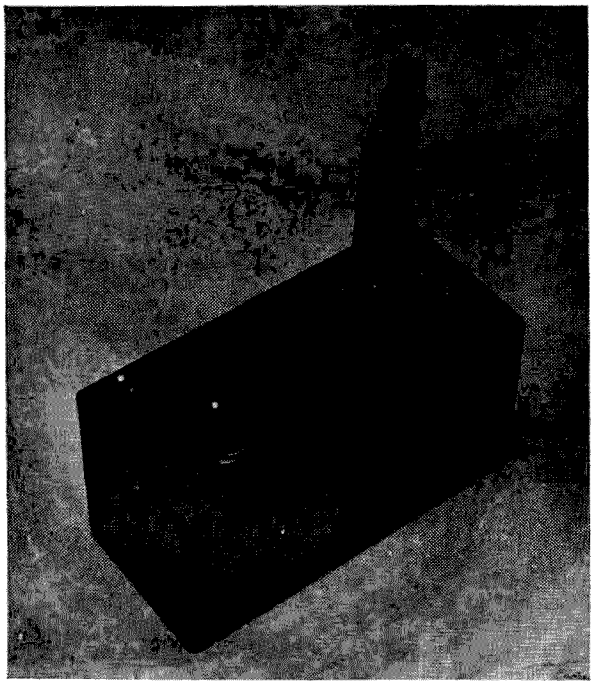


FIG. 3



Simple Transistorized Beacon Source for 144,432, and 1296

H. M. Meyer, Jr. W6GGV
260 West Beach Ave.
Inglewood, Calif.

Often during the alignment of receivers and the general check out of equipment and antennas, a signal source is required to make sure you've located yourself in the exact part of the spectrum you intended. The beacon source described here is designed to fulfill that requirement with a minimum of trouble and a maximum of usefulness. To begin with, it should be readily portable with a self-contained power supply, small, operate on a fixed frequency, have an adjustable output level and be inexpensive and easy to build.

Satisfying these requirements posed some rather interesting problems and resulted in several hours of construction time that has proven to be well spent.

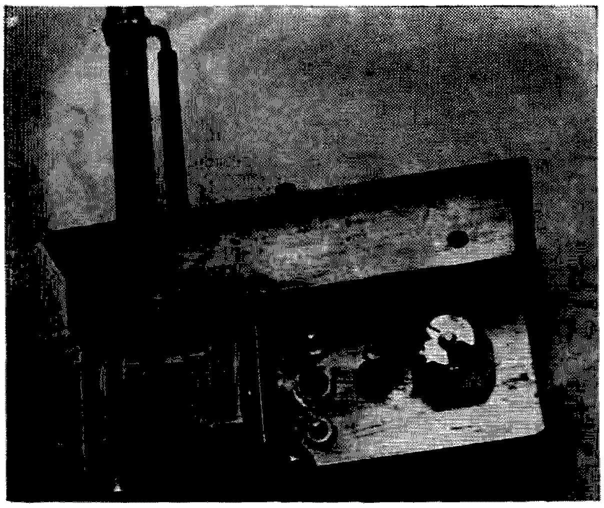
Circuit

The crystal oscillator circuit uses a Philco 2N502 transistor in an overtone circuit with a 72 mc crystal. A McCoy miniature crystal unit was used to conserve space, but there is more than enough room to use a standard size unit. The choice of frequency gives a second harmonic marker at 144 mc, a sixth harmonic marker at 432 mc and a multiplied final output at 1296 mc. If you are more interested in 6 meters than 2 meters, use a 54 mc crystal—this gives you output on the fundamental 432 mc and 1296 mc. The 2N502 transistor was used because it was available here. It is a little more expensive than some other types that would perform equally well. The circuit is straightforward and subsequent substitution of other types has yielded essentially the same performance.

The oscillator circuit supply voltage is regulated with a small zener diode through a dropping resistor to provide a bit more in the way of frequency stability. The output of the oscillator is fed directly to a diode multiplier and tuned by a $\frac{\lambda}{2}$ line tank tuned to 1296 mc. Even though the multiplication factor is 18, there is sufficient output at 1296 mc to completely quiet a 1296 mc diode mixer type converter and a 432 mc receiver. The multiplier diode, a OK 733, is one that was salvaged from a standard coil UHF TV plug-in strip that was picked up for next to nothing in a local surplus store. The DR 404 that is commercially available for about a dollar works just as well.

The entire unit is powered by a 15 volt dry battery (Burgess U10) and has a relatively long life in this service provided you remember to turn it off when you are through.

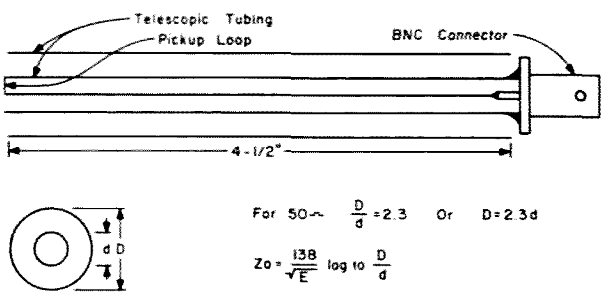
The only controls and adjustments that appear on the outside are the 1296 mc tank tuning, the on/off switch and the output jack



and attenuator. The attenuator is the device that makes the unit extremely flexible and useful. Therefore, a bit of careful attention to its construction will really pay off in the long run. Fundamentally, it is a simple coaxial attenuator using loop pick-up. It is designed for a characteristic line impedance of 50 ohms and the appropriate values of telescopic tubing were chosen to give a snug fit consistent with the proper diameter required for the center conductor.

An essential part of the attentuator is the guide that maintains the probe coupling in a fixed plane. The guide rod and sleeve technique used here is satisfactory and other methods are left to the ingenuity of the constructor. The pick-up sleeve is made long enough so that when it hits the guide stop, the pick-up loop is almost in contact with the center conductor of the line tank and parallel to it.

You can use whatever size telescopic tubing that is available or pick some up at the local hobby shop provided care is taken to keep the ratios of the inside diameter of the outer conductor to the outside diameter of the inner conductor as close to 2.3 as possible. (See Fig. 1.) If other values of impedance are desired, they can be calculated from the formula given in Fig. 1.



COAXIAL ATTENUATOR

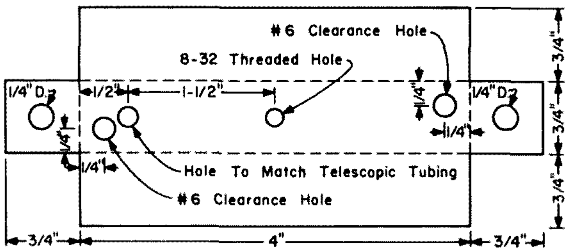
FIGURE 1

If good laboratory equipment is available, the movable part of the attenuator may be calibrated in db as a further refinement, but it is not necessary for completely satisfactory use.

Construction

The entire unit is housed in a brass box 2″ wide by 2½″ high by 4 ⅜″ long. This can be readily bent up from .03 sheet stock in a moderate sized vise. There is no strict requirement on the type of material used as long as reasonable care is taken to shield the energy that is generated. When the box is formed to proper shape, solder the corners carefully and a shielded strong unit results.

The top plate mounts all the hardware and was made from a piece of sheet brass 2″ wide by 4 3/8″ long by 1/8″ thick. It could just as well have been made from other material since the only requirement is that it be rigid enough to support the components and attenuator. The only purpose for using such relatively thick stock for the top plate was to provide enough material to drill and tap this plate to anchor the shield can. Thinner stock could readily be used if ¼″ lips were bent on the four sides. See Fig. 4.



Bend Up On Dotted Lines

FIGURE 2

The entire unit is designed to be hand held and operable leaving the other hand free for adjustment of other equipment.

The next piece to fabricate is the $\frac{\lambda}{2}$ line tank for 1296 mc. This was also bent from .030 sheet brass stock so that an open trough measuring ¾″ by ¾″ by 4″ resulted. The corners are soldered for rigidity and holes drilled before bending as indicated in Fig. 2.

Tuning for the tank is accomplished by using an 8-32 bolt with a small disc 3/8″ in diameter soldered on the end that comes in close proximity to the center conductor. The top plate is threaded and tension is provided by a nylon nut at the top. Be very careful when soldering the disc on the end of the bolt to make sure the nylon nut is flush up against the bolt head and do not disturb the

nut until the unit has completely cooled.

Next insert the center conductor. This is cut from ¼″ round tubing and just long enough to pass beyond the end plates of the tank. The center conductor is soldered in place and the additional material left sticking out is carefully filed off to make a neat flat surface.

A small L bracket was used to mount the battery and the tuning capacitors and provide shielding between the circuits. The dimensions for this are shown in Fig. 3.

After all the pieces are fabricated, mount the 1296 tank to the top plate using 6-32 screws. Use short 6-32 binding head screws with the head side in the tank. Next mount the outer conductor of the attenuator from the top of the plate so that it is flush with the inside of the tank. Solder this in place on the *top* side. Next mount the L bracket with battery clip and tuning capacitors, make sure that the on/off switch has proper hole clearance and bolt it down.

The unit is now ready for wiring. To aid in the placement of parts miniature tie points were used in conjunction with stud mounted by-pass capacitors to support all components.

The original unit constructed used a ferrite slug coil form. This was subsequently replaced by air wound coil when it was determined that a significant amount of frequency instability resulted from its use.

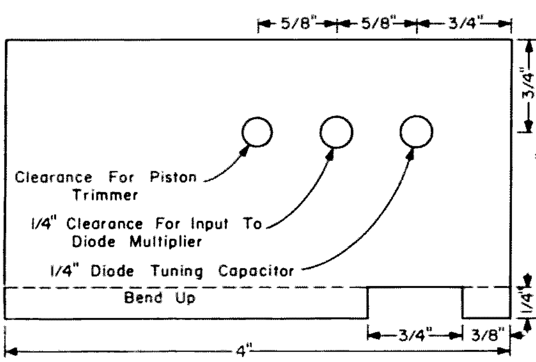


FIGURE 3

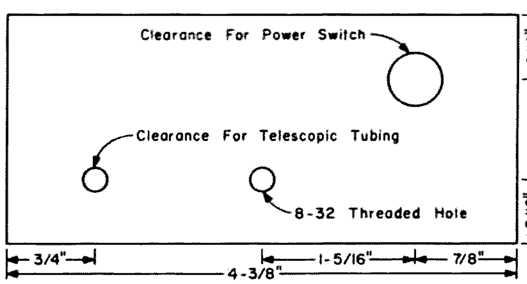


FIGURE 4

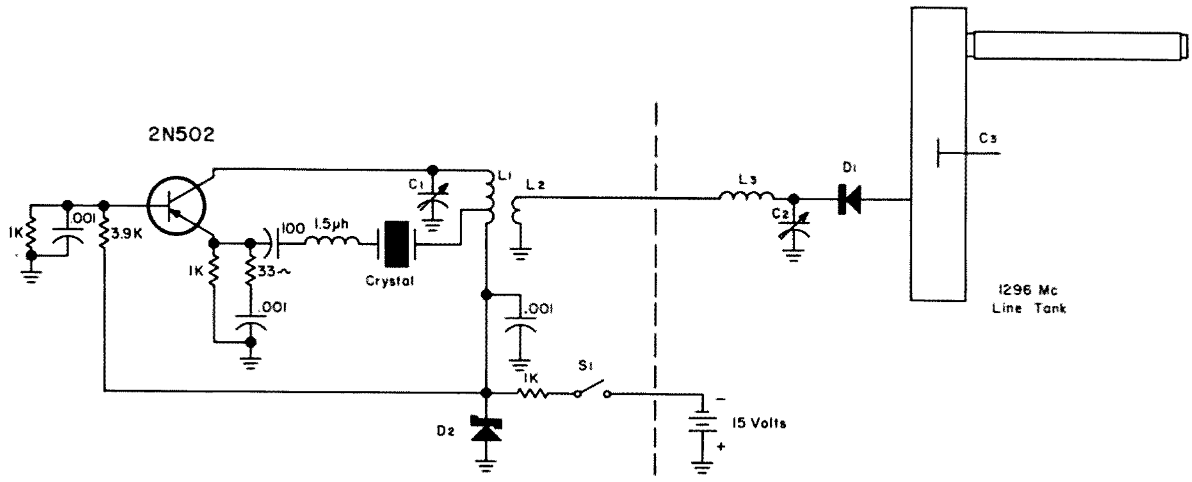


FIGURE 5

D_1—CK733 or DR 404
D_2—Hoffman in 1314 Zener
C_1—1-7 Piston Trimmer
C_2—Johnson 1-7 mmfd miniture variable
C_3—Disc

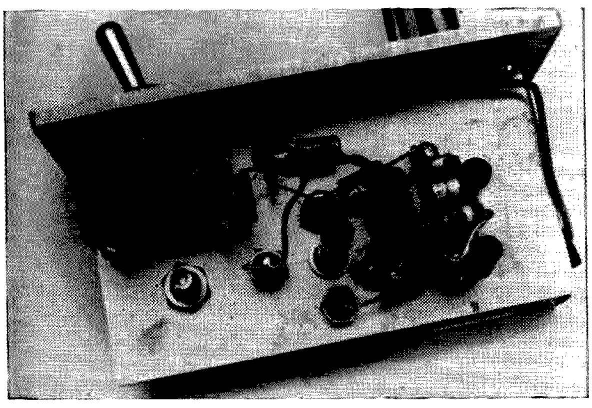
L_1—6T #20, 1/4" dia, 3/8" long tapped 1T from cold end
L_2—2T #20 1/4" dia, at cold end of L_1
L_3—9T #20 1/4" dia close spaced

Placement of parts is not critical with the single exception that the oscillator and multiplier circuits are shielded from each other. Care should be taken to anchor all components securely and ground the crystal case. The schematic diagram is shown in Fig. 5.

Adjustment

After the oscillator circuit is wired completely check all connections before applying supply voltage. Make sure the correct battery polarity has been observed. Apply voltage and with the unit lightly coupled to a receiver on 54, 72 or 144 mc, depending on your choice of crystals, tune C1 for maximum output. When this point is found, turn the supply voltage off and then on again to see if the unit is still oscillating. If not, retune C1 slightly higher in frequency until the oscillator starts up instantly on application of supply voltage.

Next solder the multiplier diode from C2 to the center conductor of the 1296 mc trough line one inch from the end plate opposite from the side of the output pick up.



Couple the output of the beacon to a 1296 mc receiver using maximum coupling to the line tank and with C2 set for approximately half capacity, adjust C3 carefully for maximum output and tighten the nylon nut. Next adjust C2 for maximum output. This adjustment will be quite broad and once set does not require additional setting. Now vary the coupling loop from the oscillator and readjust C1 for maximum output until you find the optimum coupling point. Place the shield can in place and bolt it down. You now have a completed beacon source.

After many months of use here in the shack, it was found that ready access to C1 was desirable to make minor adjustments in the exact output frequency. To facilitate this a small hole was drilled in the case opposite the C1 tuning screw. A small snap-in hole plug was used to cover the hole when the adjustment was complete.

The unit here has been used for more than one year and a half on the same battery and is still going strong. It gets more than its fair share of work, particularly when tuning up 1296 antennas. It can often be seen on top of a step ladder in the back yard with a 1296 mc ground plane plugged directly in the output jack. . . . W6GGV

Leonard Geisler AES

Squelch for the Transistorized Receiver

Tired of that "snap-crackle-pop" when monitoring a net frequency? This jim-dandy garbage disposer will firmly squelch noise, open only for legitimate signals. It also saves battery power and nerve endings in the old ears!

Although intended for use in the author's Heathkit Mariner (RDF), it will work on any transistorized communications or entertainment receiver. It is featured also, in a handy-talkie designed by the author. Only a few inexpensive parts are called for, which are non-critical. The ambitious ham can build a spider-webbed test circuit in a relatively short time; the serious amateur can install a professional version in his set in a matter of an hour or less.

How It Works

None of the resistors or other parts of the set's driver transistor are changed, only the squelch transistor is added to control the power gain of the driver.

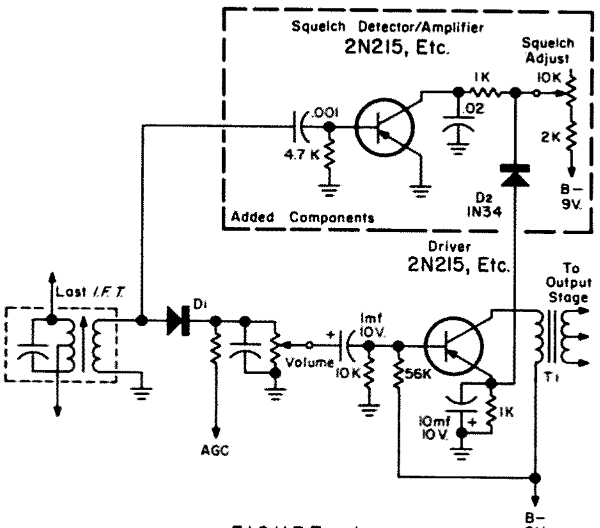


FIGURE 1

Normally, relays are used to cut off the set's speaker. In this circuit, we cut off the driver transistor, resulting in faster, noiseless and non-mechanical control. Three fixed resistors, two capacitors, an inexpensive diode and a low power audio transistor are all the parts called for. The 10 k ohm squelch adjust control may be replaced with a cheap switch and a fixed resistor, if desired.

The transistor is wired as a class B, or "plate" detector, in parallel with the set's normal diode detector. Without carrier, rectified noise is prevented from being amplified by the driver due to current flowing via D_2 to the emitter resistor of the driver transistor. This current flow raises the emitter much above the base bias, so the driver is cut off. The 10 k ohm squelch adjust resistor is set so that noise is not allowed to be heard, but a carrier, rectified by the base diode of the squelch det/amp will cause this transistor to conduct, changing the polarity—in effect—of the bias on D_2 which then loses its hold on the emitter of the driver and the driver promptly takes over, allowing us to hear the incoming signal. The 4.7 k ohm base-to-ground resistor prevents the squelch transistor from conducting on low levels of random noise. The resistor network in the same transistor's collector line serves to filter out detected AF and to distribute dc power between the squelch transistor and the driver's emitter resistor. No appreciable disadvantage results from the connection of the squelch transistor in parallel with the set's own detector. The squelch is out of circuit when the 10 k ohm resistor is run all the way to the stop away from B-.

Ref: Application data supplied by Amperex Electronic Corp., 230 Duffy Avenue, Hicksville, L. I., N. Y.

Those Fragile Transistors

Joseph Crowling K4CPR
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Warrenton, Va.

How many articles have you read that told you to handle transistors like they were made of fragile glass? I have met amateurs who were afraid to use transistors because of all the magazine articles that tell how easy it is to damage them. Don't believe it! Transistors are more rugged than any vacuum tube.

Many amateurs seem to be afraid that soldering a transistor into a circuit will ruin it. Let's pick a transistor and see what the manufacturer says. I have had a little experience with the 2N527, so let's use it as an example. The specification sheet says that you can raise the temperature of the leads (1/16 inch from the case) to a temperature of 500 ° F. for 10 seconds without damaging the transistor. I use 60-40 solder and it melts at about 380 ° F. My 35-watt soldering iron reaches a temperature of about 700 ° F. Anyone with a little experience does not need 10 seconds to make a good solder joint, and it is seldom necessary to solder within 1/16 inch of the case. Therefore, I believe that this transistor is no more easily damaged than a capacitor or resistor when soldering it into the circuit. Damage to a transistor caused by heat is usually in the form of a damaged seal (although, it is possible to ruin the solder connections inside) and is not detectable immediately after soldering the transistor into the circuit. The damage shows up as a shortened lifetime. This shortened lifetime is due to moisture and other impurities getting into the transistor and causing a gradual degradation of parameters (mainly increased I_{cbo} and lower beta). Just as in vacuum tubes, manufacturers of transistors use getters inside the cases to absorb residual gases that are inside at the time of sealing. For the preceding example, I "just happened" to pick a good transistor. Some are better and some are not. If you try soldering tubes into circuits you will find that heat damages tubes as well as transistors. If you are afraid of heat damage, use a transistor socket, they are cheap and reli-

able. Every time a new semiconductor device comes out, we find that someone has thought up a new case or lead configuration to go along with it. This creates problems for the socket manufacturers. Standardization of transistor cases would probably lead to increased use of sockets and less heat damage problems. We amateurs need not worry about all these problems. We are not concerned with extreme reliability. With a little care anyone can solder transistors into a circuit without damaging them.

I have seen articles warning about damage to transistors due to static electricity and also damage to transistors from having their leads cut by cutters with V-shaped cutting edges. Well, the above are dangers for someone who is interested in extremely high reliability for military and space applications, but amateurs need not even consider these things.

It is hard to find a vacuum tube that is as rugged mechanically as a transistor. When a vacuum tube falls off my workbench and lands on the cement below, I reach for the broom; but I would be surprised if the fall damaged a transistor. Even though a fall like this would possibly create enough G's to damage a transistor, I have seldom seen it do so.

I have used hundreds of transistors and found them to be very rugged devices. I am not saying that they are indestructible (no component is idiot-proof), and heat sinking the leads while soldering them into a circuit is a good safety precaution; but don't let anyone tell you a transistor is fragile as antique china. If you will treat them with the same care as you do other components, you will not have trouble with them.

Just for the record, I do not work for a transistor manufacturer and I do not sell transistors for a living.

. . . K4CPR

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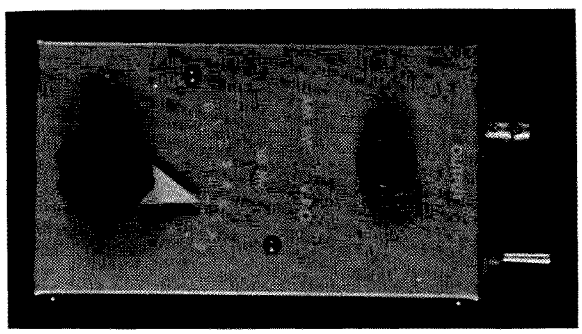
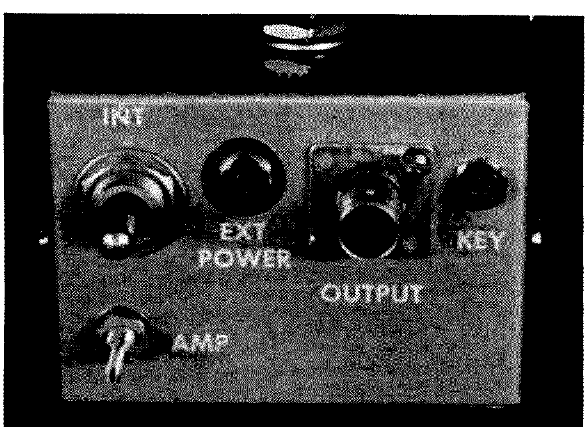
Denver, Colo. 80220

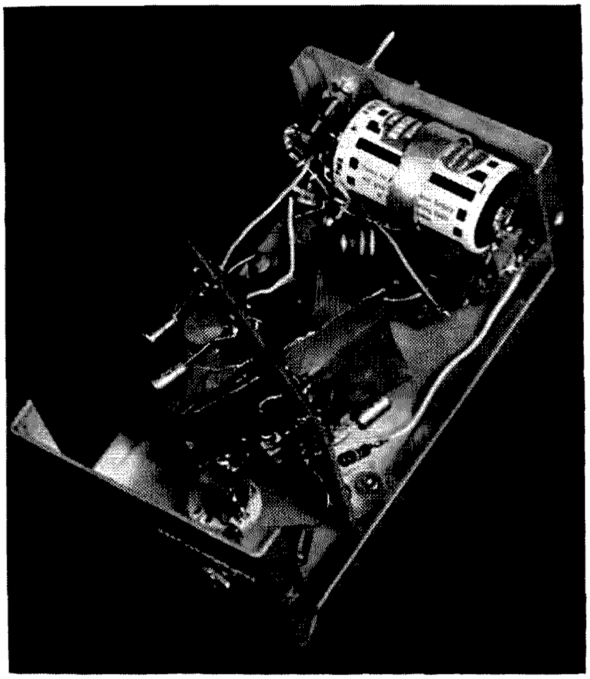
Photos by: John Taylor K7SMR

Transistor AM-FM VFO

Why not a cheap easy to build transistorized VFO? For some reason there seems to be a gap in the development of this type of ham gear. So, I decided to try it and it works even better than anticipated. The advantages are numerous. Since there is no tube to heat up the components, drift is almost non-existent as long as the voltage is stable. (This is accomplished with a Zener diode.) A bonus in the design is the ease with which it can be reactance modulated for NBFM. Excellent FM quality is obtained by merely coupling the output of a mike directly into the base of the oscillator. Frequency shift keying is accomplished by changing the bias slightly with a 100 K resistor to ground. (The shift is about 400 kc.) This FM VFO paves the way for a high powered economical transmitter since an expensive power hungry AM modulator is not required for phone operation. Any CW transmitter is instantly converted to phone with this compact oscillator. NBFM is not a disadvantage with AM receivers since any superhet receiver can copy FM very well by slope tuning slightly. When operated with external power which may be stolen from the receiver, the VFO is rock stable. An internal battery may be used, however, a slight drift may be



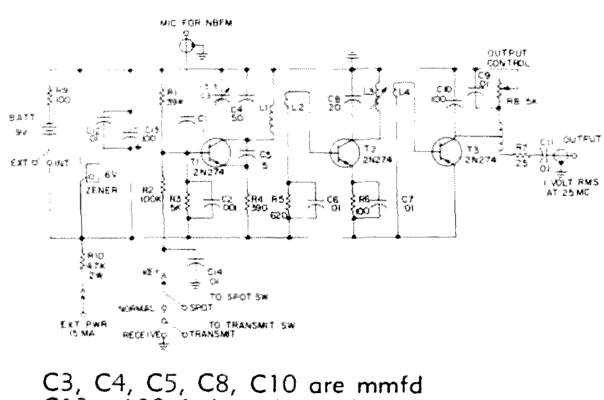




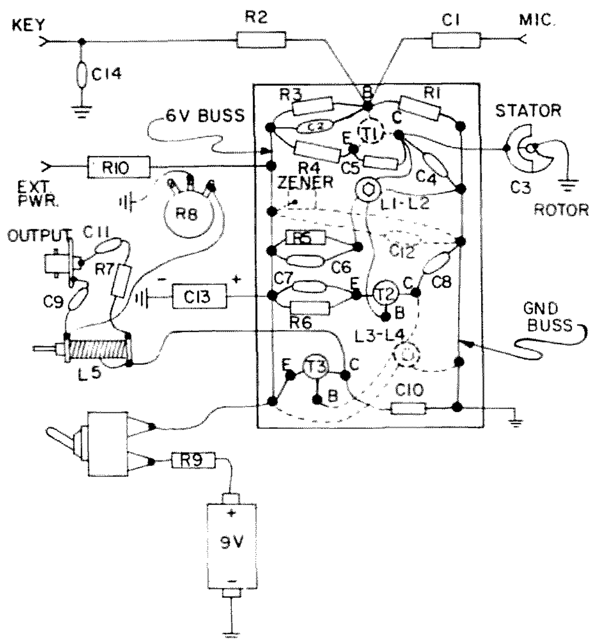
noticed over a period of time unless a mercury battery of adequate capacity is used.

Circuit Description

T1 is a grounded base oscillator which is very frequency sensitive to voltage variations at its base. By changing the resistance of R3 the amount of frequency deviation for NBFM can be adjusted to the particular microphone used. More resistance gives more deviation and vice-versa. When this VFO is used for AM the mike is unplugged from the VFO which then operates in the normal manner. T2 and T3 are conventional amplifiers which provide isolation as well. The output amplitude is controlled with a pot in the collector of T3. An autotransformer is employed in the final stage to increase the output impedance and voltage. If higher voltage is necessary to get enough drive for the transmitter, a coil consisting of 5 to 10 turns of solid insulated wire 3/8 inch in diameter, closewound, may be inserted in the transmitter between the VFO jack and the grid of the input tube. Internal power may be either a 6 or 9 volt battery. When a 6 volt battery is used, the series 100 ohm resistor is omitted. For hookup to external power, a dc supply of 50 volts or more which will handle an additional 15 ma is tapped in the receiver or converter. To determine what size dropping resistor is required, insert a milliamp meter in series with a pot of about 25 K and the VFO external power connection. Slowly decrease the resistance until the meter reads 15 ma. Measure the pot and substitute a 2 watt resistor of the same size. Be sure the internal battery switch is off when using external power.



C3, C4, C5, C8, C10 are mmfd
C13—100vf electrolytic 10-12v
6v Zener—1N429 or equiv.
L1—17T #26 wire 1/4" slug form
L2—2T on cold end of L1
L3—same as L1
L4—3T on cold end of L3
L5—25T tapped at 15T



Construction

Mount the variable capacitor, pot, switch, coil and jacks on a 5¼ × 3 × 2⅛ inches Minibox as shown in the photo. Assemble the components on a 2¾ × 1¾" fibreboard using the wiring diagram as a guide. Mount the board at an angle in the Minibox to allow easy access to the coils. Grounded sheet copper shields should be located between L1 and T2 on both sides of the board to isolate the oscillator from load changes at the output. Mount the battery at the end of the Minibox below the pot. Keep all leads well clear of the oscillator. Small rubber feet are cemented to the bottom cover.

Tuneup Procedure

Set the variable capacitor at midrange. Using a receiver tuned to 25mc as an indicator, adjust L1 for response on the S-meter. Be careful not to tune to an image. Connect the output to an FSM and adjust L2 and L3 for maximum output. Use your receiver to calibrate a dial for the VFO by hetrodyning with stations of known frequency. The dial in the photo is calibrated in tenths of a megacycle, 50.0 to 50.8. By changing the tuning of L1, any portion of the 6 meter band may be covered. It should also work well as a fundamental oscillator in the 10 meter band.

. . . WAØHQA

SOLDES

Si certains numéros de 73 vous manquent, voici une excellente occasion de compléter votre collection. Pour 5 F au lieu de 8, nous vous enverrons 4 numéros à votre choix (postérieurs à février 61). Si vous désirez recevoir une année complète nous vous enverrons toute la série pour 13 F alors que le prix normal est de 20 F. (A la rigueur nous accepterons 14 F au lieu de 13 si vous êtes superstitieux!)

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Falls Ihnen einige Exemplare von 73 fehlen, bieten wir Ihnen die Gelegenheit, diese Lücke auszufüllen. Für 4 DM statt 6, 40 DM können Sie 4 Nummern Ihrer Wahl erhalten (ab Februar 1961). Ween Sie einen ganzen Jahrgang wünschen, können wir diesen für 10 DM anstelle 16 DM übersenden.

A Transistorized Final Amplifier for Forty Meters

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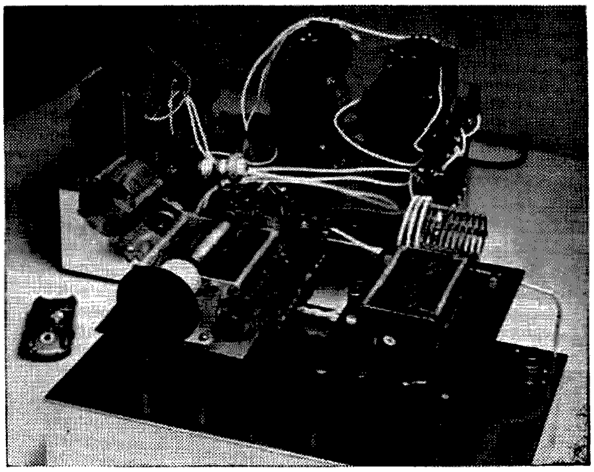
Minneapolis, Minn. 55431

Transistorized transmitters are usually either in the milliwatt class, or use vacuum tubes for the higher powered stages. Fairly high power transistor circuits have been developed even for VHF[1], and 5-watt citizens' band equipment is no longer a novelty; however the main advantages of transistors—size and power requirements—start to evaporate when the power level exceeds a few watts. If, after using transistors for years, someone suddenly invented the vacuum tube, it would be hailed as a remarkable improvement in rf power amplification.

Transistor rigs are undeniably fascinating, and make for interesting conversation. Best of all, they can be cheap! The power amplifier described here can equal the output of a 2E26 tube at 7 mc, and its total cost was under $5.00. To realize this sort of price, the surplus market must be combed for bargains. John Meshna's "85 watt 40 mc" advertisement in 73 yielded 2N1897 silicon NPN switches for $1.00 each. These will dissipate 85 watts, withstand peaks up to 80 volts, and handle average currents of an ampere or so up to about 25 mc. Some undoubtedly oscillate up to 40 mc, but their use above 7 mc is not likely to be very satisfactory. They are not intended to withstand all their maxima at



once, nor under all conditions, so we must de-rate them somewhat for transmitting use. They were a great bargain. In addition to the 2N1897, Meshna, Poly-Paks, and perhaps others feature such goodies (from less than a buck to $1.98) as 2N389 units (40 watts dissipation and they should work on 80 and 160 meters); 2N1212 60 watters up to 3 or 10 mc, depending on whose book you consult; 2N1046 germanium PNP 40 watt 15 mc transistors. The supply is likely to persist, with numbers, ratings, and prices varying somewhat. At these prices, enough can be purchased to allow selection of better units for special applications.

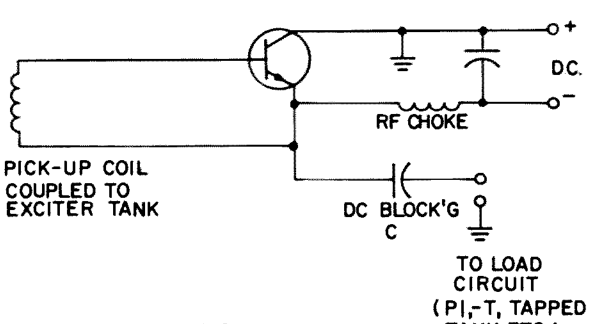
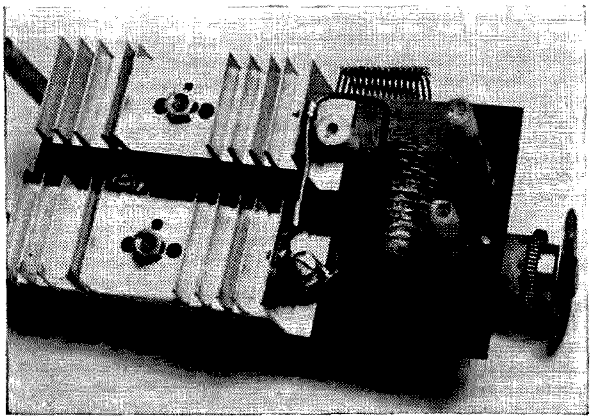


FIG. I

For the 2N1897 on the heat sink pictured, dissipation is usually limited to 10 or 15 watts. They run hot, but not alarmingly so, and one 2N1897 could probably handle all of the power that this rig has been called upon to deliver—perhaps 40 watts output. The design shown here is not the ultimate, but illustrates a stable and reasonably efficient application of these units as a basis, we hope, for further experimentation. Other similar transistors rated at 40 watts or more will operate within



their frequency limitations in similar circuits.

Most VHF designs, because of the embarrassing heat-sink-to-chassis capacitance, use grounded collector circuitry with the "bootstrap" excitation circuit to avoid degeneration. This circuit is shown in Fig. 1. In some rigs several transistors are simply connected in parallel to get more output, while others use sophisticated "parallel-pi" or "lattice-network" balancing arrangements to distribute the work evenly.[2] DC tests in the Hickock 850 transistor analyzer indicate that while straight parallel connection may be satisfactory for rf, it has limitations; so the design here includes separate base resistors—their function somewhat analogous to the small equalizing resistors used when gas diodes are paralleled. The one-ohm emitter potentiometer happened to be on hand (from a surplus assortment) and was included for balancing the currents; however it balances at dead center, so it could be replaced by two ½-ohm resistors (or just omitted, probably). By-passing such a low resistance with non-inductive capacitors is quite hopeless, and the two .2 mfd mylars are really just a gesture. Series resonating the excitation circuit (pick-up coil, base-emitter junction) would probably reduce the drive requirements. The primary objective, however, of this design was the development of a simple, efficient output circuit. Fig. 2 shows the final result with the T-network low-pass antenna coupling system.

At 7 mc, with the necessarily very low load impedances encountered, there is no reason to put the load in the emitter lead as in Fig. 1. On the other hand, there is no reason not to, and this may simplify insulation in some layouts. The coils can be computed close enough for fudging with the variable capacitor at 40 meters, and they can be squeezed in VHF applications, so that the T-network has the advantage over the PI of having only one adjustment. The old standby parallel tuned circuit with the collector tapped very near the bottom requires either a capacitor with an ungrounded rotor, or an inconveniently adjusted tap on the coil. In the T, quite reasonable values of capacitance are used—even on the lower H-F bands—unlike the other circuits. The function of all of these output circuits is to take the 50 or 75 ohm impedance of the antenna's coaxial feedline, and step it down to present some ridiculously low resistive load to the transistors' collectors. RF currents can be quite high, and coils of good design are essential.

Without going into the mathematics involved (the charts neatly sidestep that), the T-network's output antenna resistance and coil, L2, have the same effect as an inductor and a much larger resistance in parallel with the capacitor, C. The capacitor is more effective than the inductor in this combination, so it appears as a smaller resistance again, in series with a capacitor. The input coil L1 cancels the capacitance, and presents this smaller resistance to the generator as a load. An energy storage to dissipation ratio ("operating Q") of 12 or so, as is quite commonly used in parallel tuned tanks, offers excellent harmonic suppression. The T-network shown is basically a low-pass filter, and while we realize good harmonic attenuation, its use in a multiplier stage (or even driven by a multiplier) might require precautions to prevent the fundamental frequency from feeding through to the antenna.

The layout shown has the 2N1897 collectors tied directly to their heat sinks which are mounted on the insulated side of copper-laminated fiber board—insulated from the mounting screws. The input coil of the T-section, L1, is wound of number 10 wire and mounted on the opposite side of the board from C and L2 to avoid inductive coupling.

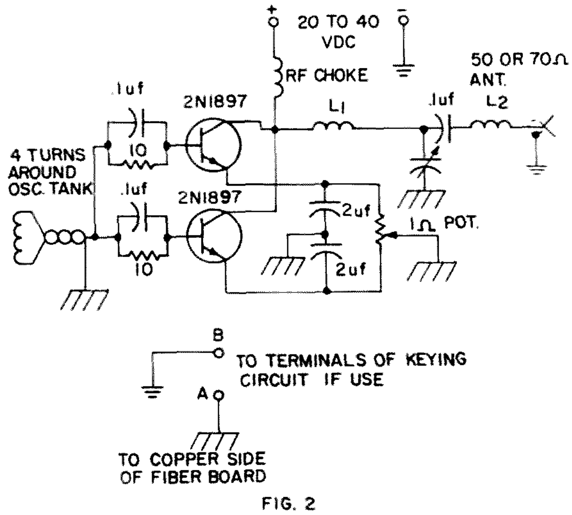


FIG. 2

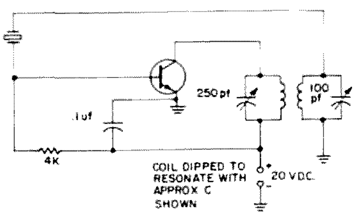


FIG 3

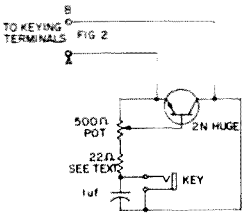


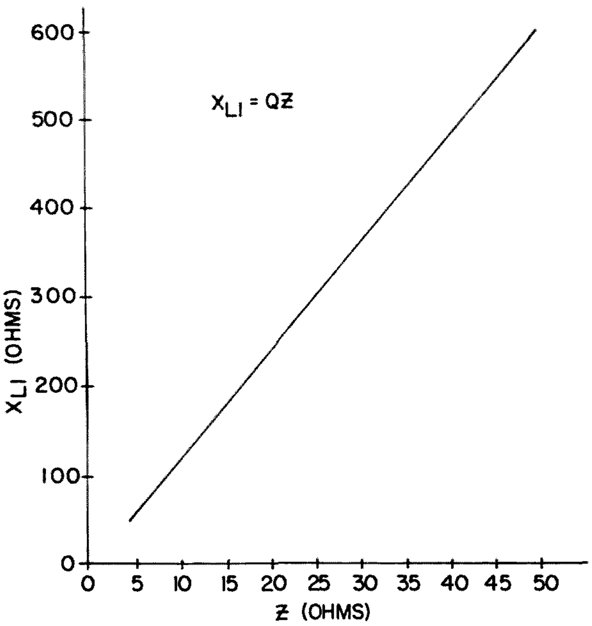
FIG 4

The rf choke is not called upon to do much, so that anything capable of carrying the rather high current involved will work. A layer of #26 wire close-wound on a ¼" dowel worked fine (about 3 or 4 inches winding length) until the single pie surplus choke in the picture was located in the junk box—it takes up less room. The dc blocking capacitor was placed between C and L2 where the current is much lower than at the collectors; this permits the use of a disc ceramic, although a good mica capacitor is generaly better where high currents must flow. The amplifier and its accompanying crystal oscillator stage were mounted on the blank chassis with plastic pillars—mostly to avoid cutting holes in the chassis, which will undoubtedly find other uses in the future.

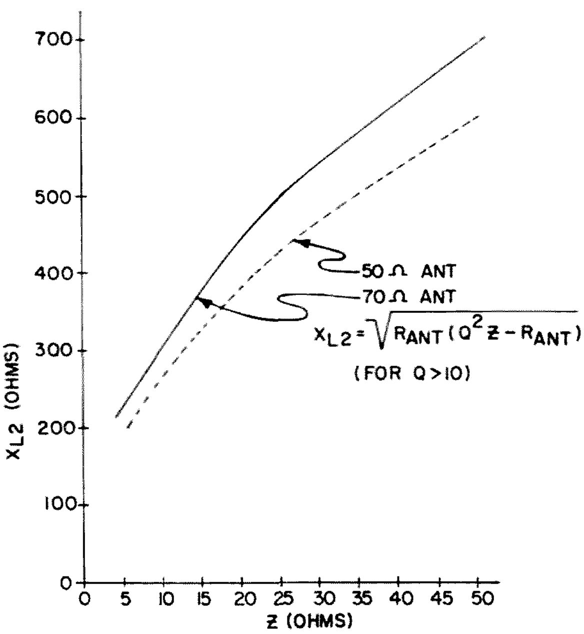
A two-tuned-circuit oscillator, as shown in Fig. 3, delivers more output than the one pictured. In any case a lot of feedback is required—use husky crystals. A smaller oscillator stage and a 2N1897 buffer are planned for the amplifier, or even a VFO, which would require several additional stages, since the internal heat developed in large transistors would wreck the stability.

The transmitter was intended to operate at 20 to 24 volts dc supply voltage, although voltages up to 40 volts have been used with no failures. The source of 12, 24, and 40 volts filtered dc at several amperes is no problem at all on the surplus market. The supply shown uses a two-output bridge with tapped transformers for further flexibility. It supplies 6 amperes, has 24000 mfd of filter capacitance and a 3 ampere choke in each output's filter. It cost less than $15.00 for parts—mostly from Meshna's catalog. Perfectly adequate dc sources can be built for considerably less.

New modulation circuits for transistorized rigs[3] have been designed integrally with the rf circuitry. Their designer is apparently unfamiliar with normal amplitude modulation criteria, and is certainly unfamiliar with the proper terminology used around transmitters, but he offers excellent solutions to the problem of modulating battery-operated CB equipment. With this higher-powered HF rig, tests indi-



cate that ordinary collector modulation will achieve good linearity up to 60 or 70 per cent—about all that normal speech averages anyhow. This requires that the dc supply voltage be kept around 20 volts, a value that should always be used for tuning and testing before higher voltages are applied. For use as a linear amplifier, modulating the preceding stage, good operation can be obtained using about 40 volts dc if the output is properly loaded. A combination of collector modulation and some modulation applied to the preceding stage will undoubtedly allow higher modulation capabilities. The only attempt at modulation actually tried on the air was simply plugging a carbon microphone into the key jack, using the keying transistor circuit



of Fig. 4. Turning down the base current below saturation, this allowed readable 'phone transmission, but was not analyzed for distortion or modulation percentage. Any attempt to combine the keying and modulation circuits could include an increase in supply voltage when the keying transistor is not saturated, since it is basically a series modulation system. Several surplus transistors were tried in the keying circuit, and finally one (unmarked) was found that worked. It should be a big brute such as a 2N174 or 2N1970, but don't buy a new one until you try what you have. Adjust the potentiometer toward the collector end until the collector current stops increasing, and if it is not saturated at the bitter end, use a higher-gain transistor or a smaller resistor in place of the 22 ohms which is to limit base current to a safe level. This circuit keys both stages, and no filtering is required when the oscillator and amplifier are keyed together.

The most unusual part of this amplifier's design is its tank circuit which may be employed wherever similar impedance transformations are required. The curves, Fig. 5, require a bit of computation, but no higher mathematics. If you don't feel up to it, any neighbor ham of high-school age will get a kick out of exhibiting his algebraic facility, and will solve the problems for you. A high degree of accuracy is not essential; slide-rule answers are just fine. Follow the step-by-step instructions (referring to the example) as if you were wiring a kit. Here they are:

1. Determine the desired load impedance, Z, from $Z = \frac{E^2}{2P}$; where E is the dc supply voltage, and P is the anticipated power output (let's keep it below 40 watts).
2. For this Z and the 50 or 70 ohm antenna you intend to use, find the reactance values for L1, C, and L2 by referring to Fig. 5.
3. Find the capacitance to represent the proper reactance for C on the frequency band you intend to work—use a variable from the junk box that will tune through this value.
4. Find the required inductance values for the coils, L1 and L2 and wind them up out of suitable wire from the junk box (or borrowed from a friend). The reactance and inductance formulas are given in the following example.

If you are an old hand at ac theory, you can skip this paragraph, but here is how this

particular circuit was designed. An output of 20 watts at 20 volts dc supply voltage was anticipated. The load impedance required should be about 10 ohms from step 1:

$$Z = E^2 \div 2P = 20^2 \div 2 \times 20$$
$$= 400 \div 40 = 10 \text{ ohms}$$

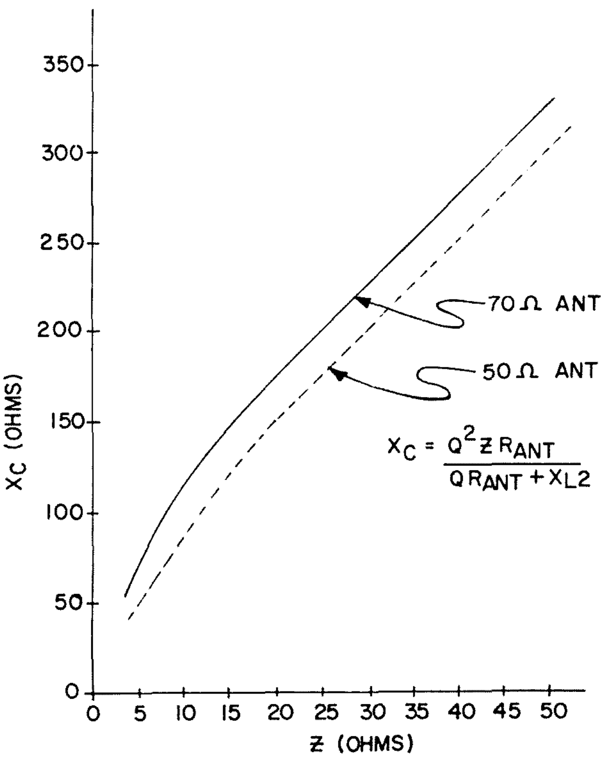
Consulting Fig. 5, and selecting values for a 50 ohm antenna yields these values: X_{L1}= 120 ohms; X_{L2}=260 ohms; X_C=83 ohms. The approximate formulas shown on the curves could also have been used, not because any additional accuracy is necessary, but because other values of q, Z, or R_{ant} might be desired. The reactance formulas, with f=the frequency in megacycles, are

$$L_{\mu h} = \frac{.159X_L}{f} \text{ \& } C_{pf.} = \frac{159000}{fX_c}$$

which give L1=2.7μh., L2=5.9 μh., and C= 275pf. To find the number of turns on the coils, after choosing a convenient radius and winding length (radius=r inches, length=b inches), try

$$N = \frac{1}{r}\sqrt{L_{\mu h}\,(9r + 10b)}$$

L1 as shown was about 1½ inches long, ½ inch radius, requiring 14 to 15 turns. L2 is ¾ inch radius and 1¼ inches long, and also required about 14 turns. L1 carries much heavier current, so it was wound of #10 wire, while #18 was adequate for L2. In



spite of the approximations and the shortcomings of formulas purported to apply to small air-core coils, these values are quite satisfactory.

With no excitation applied to this type of amplifier, it simply draws no current, so there is no need to key it if the oscillator keys well alone, or if any existing keyed exciter is utilized. About the only precautions which must be observed in tuning are to keep the base-emitter circuit complete (do not open the excitation pick-up coil with dc applied to the collectors), and to keep the collector voltage down until tuning, testing, and experimenting are finished. Don't expect a neon bulb to light, except perhaps on the capacitor stator, as there are no real high-voltage points. Tune for maximum current. If you can touch the transistor with your finger without smelling meat burning, it is probably not too hot. In cases of extreme mis-match, it would be well to check for harmonic output before operating, but the T-network is really quite tolerant of small varitions in impedances as the curves show. For full output use plenty of excitation—remember that some of this will find its way to the antenna, unlike a vacuum tube amplifier where the drive simply heats the grid.

A rig like this will work as well as any conventional transmitter of equal power on the same band, and delivers enough output to work around the world. In spite of the disadvantages, putting your rf power transistors to work has these good points: it's easy, it's fun, you're bound to learn something, and it's CHEAP!

1. Boelke, Dolby, & Moss, "An Experimental 20 Watt 160 Mc. Transistorized CW Transmitter," "Solid State Design," June 1962.
2. W. A. Rheinfelder, "Transistorized Transmitter Output Circuits," "Electronic Equipment Engineering," October 1963.
3. W. A. Rheinfelder, "Modulation Techniques for Transistorized AM Transmitters," "Electronic Equipment Engineering," July 1963; and "Modulation Circuits for Solid State CB Transmitters," "Electronics World," Feb. 1964.

Minute Kilowatt Power Supply

Louis Adler K8IKA
2822 11th Street
Cuyahoga Falls, Ohio

Sounds ridiculous doesn't it? I thought the very same thing. Recently I've seen a number of kilowatt supplies in the three popular ham magazines. But in every one I noticed they're still using a transformer of large dimensions.

A friend of mine, K8UYZ, recently sent me a schematic of a silicon power supply. So while I was on vacation a month ago I decided to build this up, with the intentions of incorporating this in my linear amplifier.

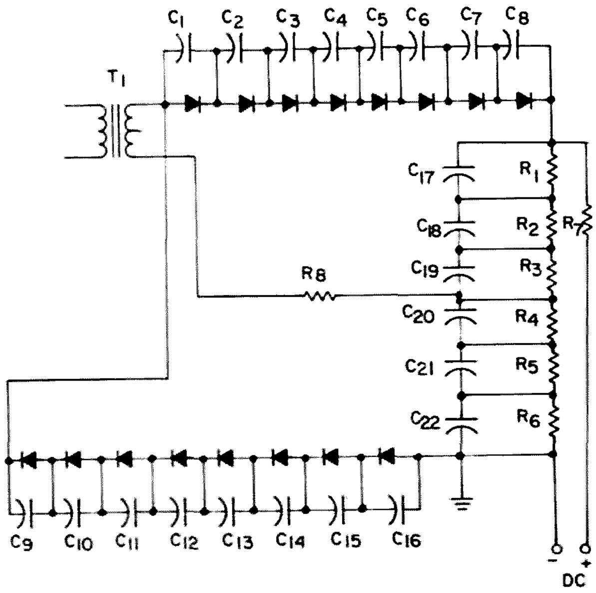
I built this linear from an article in 73 about 9 months ago, using four 811A's in grounded grid. For the power supply I used 2 1400 volt transformers in series and a pair of 3B28's for rectifiers. After rectification and filtering I only had 1100 volts to the finals. This is one of the reasons for trying the new power supply.

The power supply has been revised to bring it down to the barest minimum of parts. You can actually build this power supply in a cabinet the size of a cigar box. I'm leading up to the basic difference shortly.

The first day of my vacation I went down to a local electronics parts store to dicker on the parts for this power supply. I had some used parts I could have used in this experiment but felt I would be much better off using new parts throughout. Of course the 16 silicons cost a pretty penny, but when I told the man I'd need six electrolytics, 100mfd at 450v, six bleeder resistors, and 16 .01 disc condensers, he gave me a real good deal on the silicons. The bill on all of the parts minus the transformer came to a little over thirty dollars. I came home with the new parts and started to work.

Construction

I mounted 3 electrolytics and 3 bleeder resistors on a piece of ¼ inch plexiglass. The size of this plexiglass was 3 inches by 5 inches long. I drilled four holes on each end and mounted ground lugs to attach the electrolytics with a bleeder resistor mounted across each electrolytic. It makes a neat little pack-



T1 800 to 850 VAC 0 350 to 500 mr.—
C1 thru C16 .01 disc ceramic 600 V.—
C17 thru C22 100 mfd electrolytic @ 450 V.—
R1 thru R6 25K. wire wound 25 watt.—
R7 5 ohm 10 watt.—
R8 10 ohm 10 watt.—
16 Silicons 750 ma—600 PIV Mallory 1N3195
Output 1700 to 1800 VDC.—
Do not use a choke.
Do not use center tap.

age. Of course the electrolytics are hooked up in series, so you'll have two electrolytics on one side of the plexiglass and one on the other. Drill two holes on one long side and mount a right angle bracket in each hole and you have a way to attach this unit to the chassis. I made two of these units up and mounted them on an old chassis I had lying around.

Now I mounted the silicons and .01 condensors on a piece of surplus terminal board which happened to have 16 pairs of terminals. In mounting these units to the chassis make sure you have plenty of clearance between the components and the chassis so there is no chance of arcing.

Now comes the apex of the article. The schematic called for a transformer with the rating of 800 to 850 volts across the secondary and rated at 350 to 500 ma. Well, in searching through my stock of transformers, the only thing I could find was a TV transformer which had 900 volts across the secondary and how many mils it was good for was anybody's guess. There were no numbers or other identifying marks to search out any information on this transformer. But I'll say this, it is of the average size and not one of the rare large ones. By the size of this transformer I surmised that most TV transformers are rated at 250 ma and this one was in this category.

I figured the worst that could happen was that the transformer would burn out and then I'd have to look for another. I went into the linear and disabled the original power supply. Remember I said I built the new power supply on an old chassis, so I used jumper wires to the linear and double checked all of my hookups. One thing I might point out is to make sure not to overfuse the primary of the transformer. In my case I used a 5 amp fuse in each leg of the primary.

Well the big moment had arrived. I threw on the filaments on the linear and hooked a 500 watt bulb to the final for a dummy load. I turned the power on the primary and checked with a multimeter and with no excitation on the linear I had 1800 volts. I turned on the exciter and fed a signal into the linear and loaded up the linear for all she was worth. After about 3 minutes with a CW carrier I blew a 5 amp fuse. This I felt wouldn't bother me too much because I only operate CW and SSB. On checking the voltage to the finals with the key down, I found I had 1650 volts and the four 811A's were drawing 550 ma. This gave me a 907½ watt input signal.

Fine I thought, but how well was this transformer going to hold up? I attached a 75 meter antenna to the linear and loaded it up. The first evening I was on for 2½ hours and after that period of time the old TV transformer was hot enough so it wasn't comfortable to put the back of your hand to it.

This gave me an idea, I had overlooked the cut off bias on the 811A's. Of course I had it available in the exciter. The next day I attached this cut off bias to the finals so that when I was in the idle position at least there was no current draw against the transformer. This of course gave the TV transformer a rest once in a while. It also worked beautifully because the old transformer ran cool after being on the air for 3 hours.

The third day after testing this experiment I was still dubious as to whether or not she was going to hold up. I fired up first on 75 meters, then later moved to 20 meters. Eight and a half hours later I found the transformer was still luke warm. This proved it to me.

I tore the original power supply out of the linear the fourth day and using blank pieces of aluminum to cover the holes in the chassis, I built this new power supply into the linear. Of course, with this new power supply, I had a 1/3 gain over the original power supply.

It's been a month now since I've done this

and do you know, that old TV transformer is still doing a terrific job. There's one thing I think most of us forget about a transformer. When they rate them they're rated for continuous use. So this, plus the cut off bias on the finals is the answer to this mystery. To prove a point, I just recently acquired a TV transformer of known ratings and fired it up on this power supply and got the same answer as the original transformer.

I've mentioned this on the air many times and everybody is astounded. I've been called a liar as well as being praised for this. So people, this is what prompted me to write this article.

The schematic for this power supply was drawn up by K9EVJ, and all my thanks to him for getting it up to Dave K8UYZ, a mutual friend of ours. If you doubt this story about the TV transformer just drop in on 3910 any evening and you'll hear this signal.

In closing, I can add this: the power supply was not designed for AM, but puts out a clear CW note. Also don't use any of the filament windings if you elect to use this type of transformer. The secret of being able to use a TV transformer for this power supply is the fact that it's only intermittently used. Dig out an old TV transformer and give it a whirl. You'll be surprised at the power in that little old hunk of iron.

. . . K8IKA

The Signal Helper

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Want to add some poop to your receiver at the expense of only half an hour's effort and two bucks worth of parts? You can, by adding an untuned transistor preselector between your antenna and Old Faithful's present input. Actually, this little circuit has two other advantages besides gain: By using the present receiver input tuned circuit as its load, gain is peaked at the tuned frequency, so rf selectivity is improved without adding any tuned circuits, and, on receivers deficient in this department, the signal-to-noise ratio can be improved. Since no major surgery is required, resale value of the equipment remains unaffected.

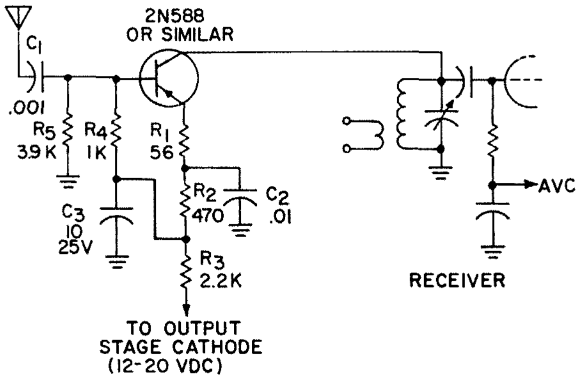


FIG. 1

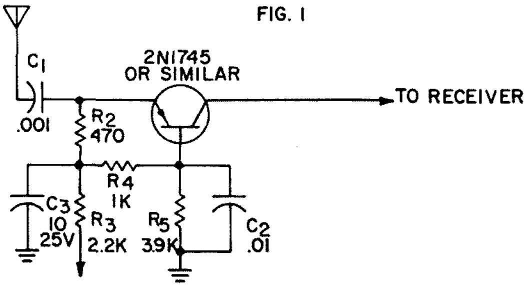


FIG. 2

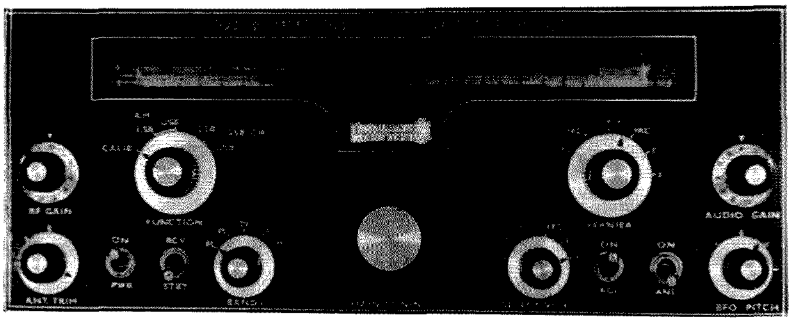
Fig. 1 shows the common-emitter configuration, which works well up to and including six meters. The transistor's collector goes to ground through the secondary of the input transformer. If by chance your receiver has this connected to the AVC line instead of to ground, it is a simple matter to insert a blocking capacitor, apply the AVC after it, and then ground the transformer as per the diagram. Leave the primary disconnected. The grounded-base configuration of Fig. 2 is more suitable for 144 and 220 mc. Power can be obtained from the most convenient source of low voltage dc, the audio output stage's cathode. R_1 is very important; the degeneration introduced by this resistor helps quite considerably in minimizing cross modulation.[1] (The grounded-base configuration does not require this, since it is inherently less sensitive than the other.) After assembling, repeak the trimmer capacitors of the rf stage to compensate for the added shunt capacitance. Then listen.

This little gadget offers a lot of performance for the effort required to build it. You might find it a useful addition on all receiving equipment which leaves something to be desired, including mobile equipment, the XYL's AM broadcast radio (keep her happy!), and your FM tuner.

. . . W3WJN

REFERENCE

1. C. D. Simmons and J. Specialny, "Cross Modulation in Transistor Tuners" Philso Application Lab Report 775, October, 1962.



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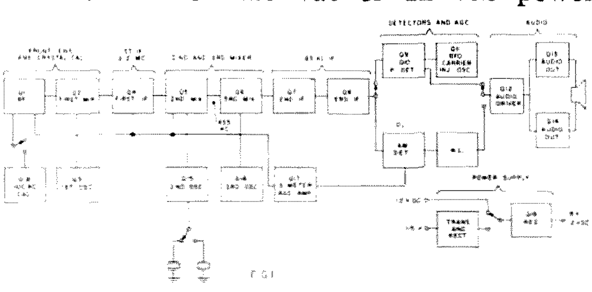
High Performance Transistorized Communications Receiver

This article will describe a transistorized communications receiver designed to cover the amateur radio frequencies from 3.5 to 30 mc. A complete performance analysis of several of the top line vacuum tube receivers was made for the purpose of determining the present state of the art of vacuum tube communications receivers designed for this service. As a result of this study, it was decided that at least a double or triple conversion receiver with variable selectivity in the *if* strip capable of AM and SSB-CW reception was required. This receiver, therefore, was designed to compete, from a performance standpoint, with today's high quality vacuum tube receivers. It operates from either 115 volts ac or 12 volts dc, making it useful not only as a fixed station receiver but also as a portable or mobile receiver.

Circuit

A block diagram of the receiver is shown in Fig. 1. It is basically a triple conversion superheterodyne receiver employing a tuned rf stage and variable selectivity in the last *if* stages. The three intermediate frequencies are 2.2 mc, 455 kc, and 85 kc. The receiver operates from either 115 vac or 12 vdc power sources, and covers the amateur radio frequencies from 3.5 mc to 30 mc in five bands.



The incoming signal is amplified in the rf stage and converted in the first mixer to the first *if* of 2.2 mc. A single stage of amplification at 2.2 mc is included after which the signal is fed to the second mixer and converted to 455 kc. The 455 kc signal is again converted in the following stage to 85 kc.

Variable selectivity is achieved in the 85 kc *if* amplifiers by a method explained later. The output of the 85 kc *if* strip is fed to either one of two detectors depending on whether AM or SSB, CW reception is desired. Following the detectors is a two stage audio amplifier which develops approximately two watts of audio power across a 3.2 ohm speaker impedance.

Each of the seven sections of this receiver as outlined on the block diagram in Fig. 1 will be covered individually in the description which follows, and where applicable, pertinent design considerations will be included.

A complete circuit of the receiver is included, along with the important performance characteristics. The receiver contains ninteen transistors and six diodes.

General

At the onset of the design of this receiver, it was decided that at least double and possibly triple conversion would be required. To achieve the desired selectivity and still maintain a small physical size for the overall receiver, it was decided that an *if* of 85 kc was desirable. The state of the art of high quality

communications receivers dictated that a scheme of variable selectivity be included. The 85 kc *if* lends itself to a very reliable and fairly simple method of variable selectivity which contributed to the selection of this frequency for the *if* stages.

The choice of the first *if* frequency involved several considerations. It had to be lower than the lowest frequency, 3.5 mc, to which the front end is to be tuned. To prevent *if* pickup of broadcast stations, it had to be higher than the standard broadcast band, 540-1610 kc. These two factors limited the range of the *if* to between 1.7 and 3.5 mc. The first *if* frequency also had to be high enough to produce an image frequency sufficiently removed from the incoming signal frequency to allow the front end coils to provide the required image attenuation. Usually, 50 db image attenuation is adequate for most communications receivers. Where practical, the image frequencies should lie outside of the band of frequencies to be tuned and should not occur on any frequency where a known station of high power is transmitting. Such stations would be government short wave broadcast stations. With these considerations in mind, the first *if* was chosen to be 2.2 mc.

At this point, it was evident that with a last *if* of 85 kc, the associated image frequencies were too close to the first *if*, 170 kc away from center frequency, to be sufficiently attenuated by the first *if* tuned circuits. For this reason, it was decided to employ triple conversion. It was found that with a second if of 455 kc, the image frequencies associated with the third conversion step could be adequately attenuated. Likewise, the image frequencies produced in the second conversion step could be attenuated by the 2.2 mc *if* transformers.

Another factor considered in the development was the frequency of the local oscillators and their harmonics. As far as practical, the frequencies of the oscillators were chosen such that their harmonics fell outside of the pass band of the receiver.

Front End and Crystal Calibrator

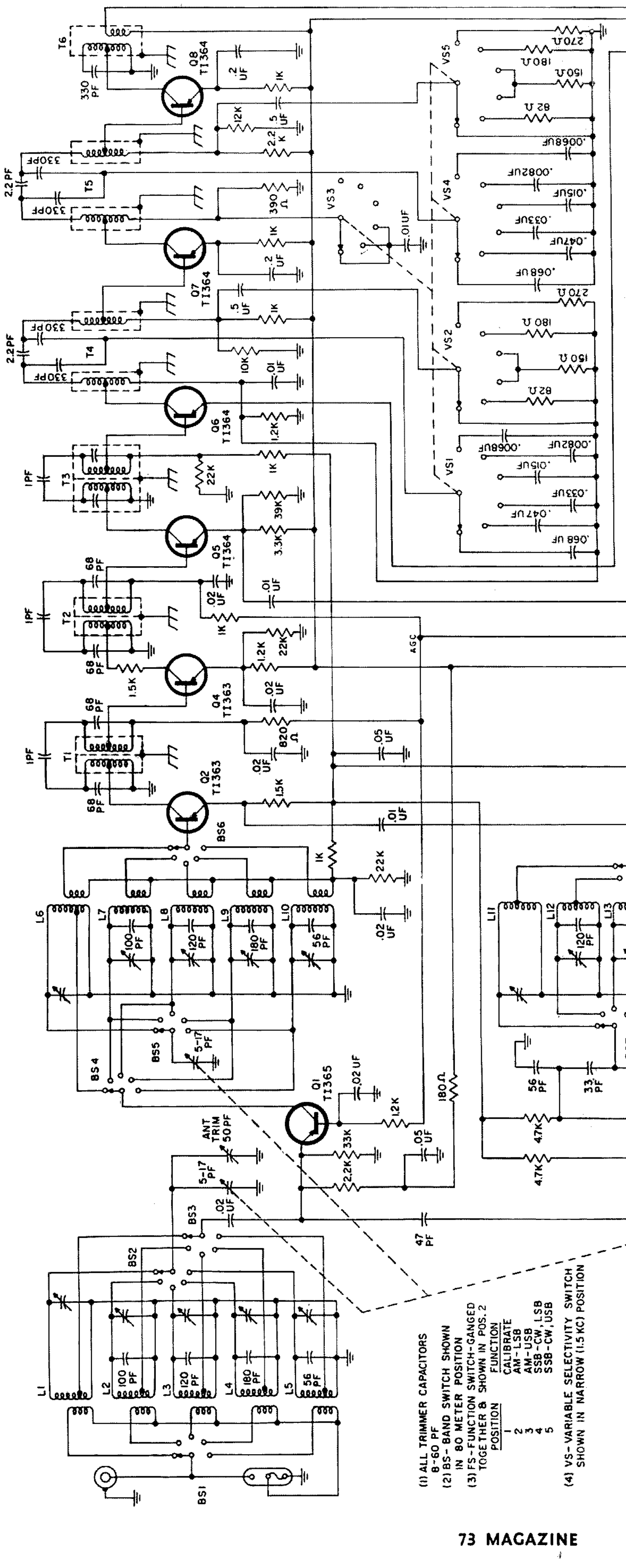
The rf amplifier, Q_1 in Fig. 2, consists of a single stage common base amplifier with single tuned input and output coils. It covers all amateur radio frequencies between 3.5 mc and 30 mc in five steps.

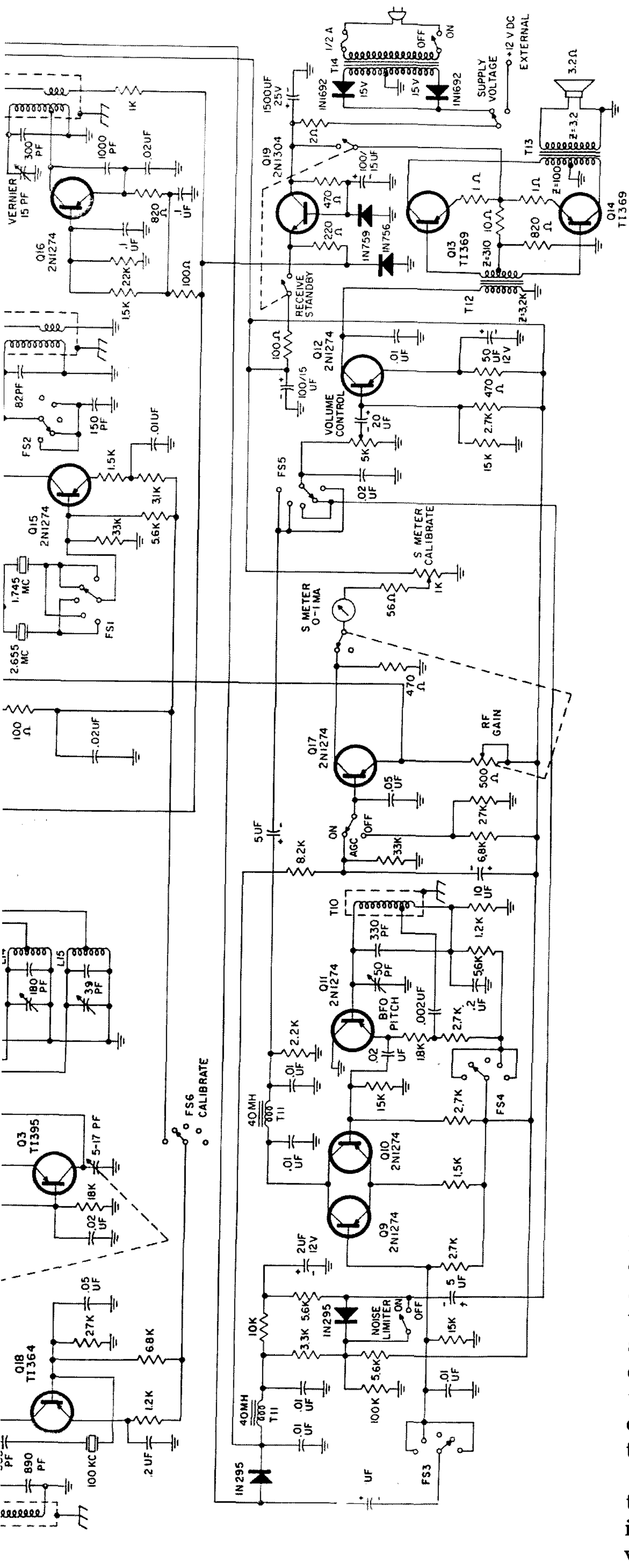
Reverse AGC is applied to the base of Q_1, and its Quisent current is set to provide minimum noise figure when low level signals are being received. For the Dalmesa transistor used in this circuit, minimum noise figure is

produced with a collector current of approximately 300μa. This collector current is also an ideal current at which to operate for AGC reasons as is shown in Fig. 3. At this current level h_{fe} has started to decrease quite rapidly with decreasing collector current and, therefore, a small decrease in current will produce a relatively large decrease in gain of the stage. To improve the overload performance and AGC characteristic, the emitter of Q_1 is biased from a voltage divider network rather than with the conventional single resistor. The voltage divider on the emitter of Q_1 holds a negative voltage at its emitter with respect to B+ when Q_1 is not conducting. In order for collector current to flow, the base of Q_1 must be more negative than its emitter by an amount equal to the V_{BE} required to produce the desired collector current. This negative base voltage is derived from the AGC line and applied to the base of Q_1. The AGC voltage, being a function of incoming signal strength, is capable of being reduced to zero under strong signal conditions. With a conventional circuit, the current through Q_1 would be reduced to zero when the AGC voltage applied to its base is reduced to the value of V_{BE} required just to sustain collector current flow or approximately .15 volts. With the voltage divider circuit, the current through Q_1 is reduced to zero when the AGC voltage drops to the value of the emitter bias voltage plus the value of V_{BE} required just to sustain collector current flow. With the voltage divider on the emitter, the current through Q_1 and, therefore, its gain is reduced at a much faster rate for increasing signal strength than is ordinarily achieved with conventional bias, and thereby producing a better AGC characteristic.

The choice of the loaded Q of the antenna and rf coils is selected as a compromise between image rejection, noise figure and physical size. As previously stated, a high quality receiver should have at least 50 db image rejection and at least a 1 μv sensitivity or better for a 10 db signal to noise ratio. For any given physical coil size, the signal to noise ratio may be improved by sacrificing image ejection and vice versa. It was decided that this receiver should have at least the above mentioned specifications in addition to a small physical size.

Tuned circuit theory for two single tuned coils will yield a value of loaded Q to achieve the desired attenuation at the image frequency. The loaded Q of the antenna coil was made as low as possible to keep its loss to a minimum, since loss in the antenna coil con-





tributes directly to the noise figure of the receiver. The loaded Q of the rf coil was made somewhat higher to provide proper image rejection. The image frequency for this receiver which must be attenuated by the rf coils is 4.4 mc or twice the first *if* above the desired signal frequency. The rf coils of this receiver were designed to provide at least 60 db rejection on the three lowest bands and at least 50 db rejection on the two highest bands to their associated image frequencies.

The first mixer stage, Q_2, is a conventional common emitter stage. The incoming rf signal is applied to its base and converted to the first *if* 2.2 mc. The oscillator injection voltage is applied to the emitter of Q_2 through a capacitor from the oscillator tank coil.

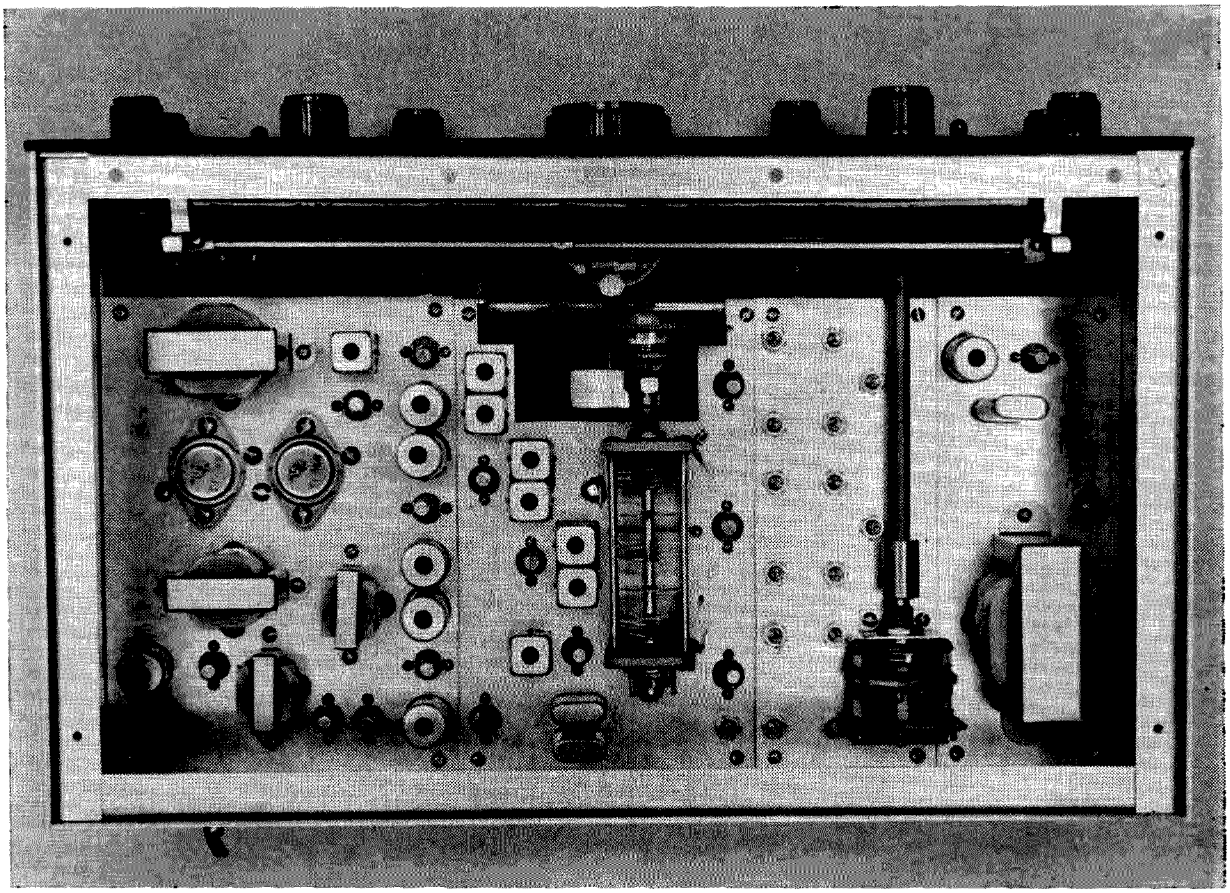
The first conversion oscillator, Q_3, is a common base Colpits circuit. The oscillator tank coil is tapped at a point which provides approximately 500 mv of oscillator injection voltage to the emitter of Q_2. The conversion gain of the first mixer is a function of the oscillator injection amplitude. Any injection voltage between 0.1 v to 1 v provides maximum conversion gain. At injection levels above or below these limits, a reduction in conversion gain occurs. Large signal levels cause spurious responses to be generated if the injection voltage is much lower than 500 μv. Larger injection voltages are not necessary but could have been used if so desired up to the upper limit of approximately 1 v.

The 100 kc calibrator, Q_{18}, is a crystal oscillator circuit which provides harmonic signals every 100 kc through the frequency range of the receiver. This signal is fed into the emitter of Q_1 when it is desired to check the receiver calibration. The incoming signal from the calibrator oscillator is "zero beat" against the bfo and the dial pointer set to the proper division on the receiver dial.

First if Stage

The first *if* stage consists of a single common emitter amplifier with double tuned input and output transformers. The image frequencies which are attenuated by this *if* stage are two times the second *if* above and below the incoming signal. These two frequencies are converted in the first mixer to produce either 2.91 mc or 2.09 mc. The loaded Q of the two double tuned first *if* transformers was chosen to provide at least 60 db attenuation to these two image frequencies.

For maximum signal handling capabilities, the collector of Q_4 should be loaded into an impedance equal to the collector-emitter voltage divided by the collector current. Un-



der large signal conditions, the collector current is at a minimum since it is controlled by the AGC line. This dictates that the collector see as high an impedance as possible for overload reasons. On the other hand, if the collector is loaded into too high an impedance, instability can occur. The collector was, therefore, fed into an impedance which was somewhat lower than that desired for maximum signal handling capabilities, and somewhat higher than that desired for maximum stability. Overloading usually occurs in later stages in the receiver. Therefore, this may be done with no sacrifice in overload ability. The voltage divider on the emitter of Q_4 is used for the same reason as that of the rf stage.

Second and Third Conversion Stages

The method used to achieve the second and third conversion steps is illustrated in the schematic. As explained earlier, the 455 kc transformer is used to provide attenuation to the third conversion image frequencies. These image frequencies are two times the third *if* of 170 kc either side of the desired incoming rf signal. These frequencies are converted to either 285 kc or 625 kc and are rejected at the 455 kc tuned circuit.

In general, there will be only one direct image frequency associated with each conversion step. However, since the second local oscillator operates either 455 kc above or below the first *if*, there are two additional image frequencies associated with this receiver. These two extra image frequencies are symmetrically spaced above or below the center of the *if* with respect to the normally associated images. Therefore, if the *if* transformers are designed to reject the normal images, the two additional images will also be rejected.

With the type of variable selectivity used in the 85 kc *if* strip, the center frequency

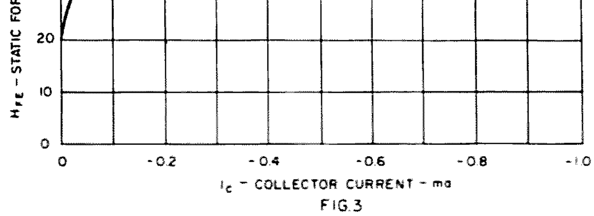
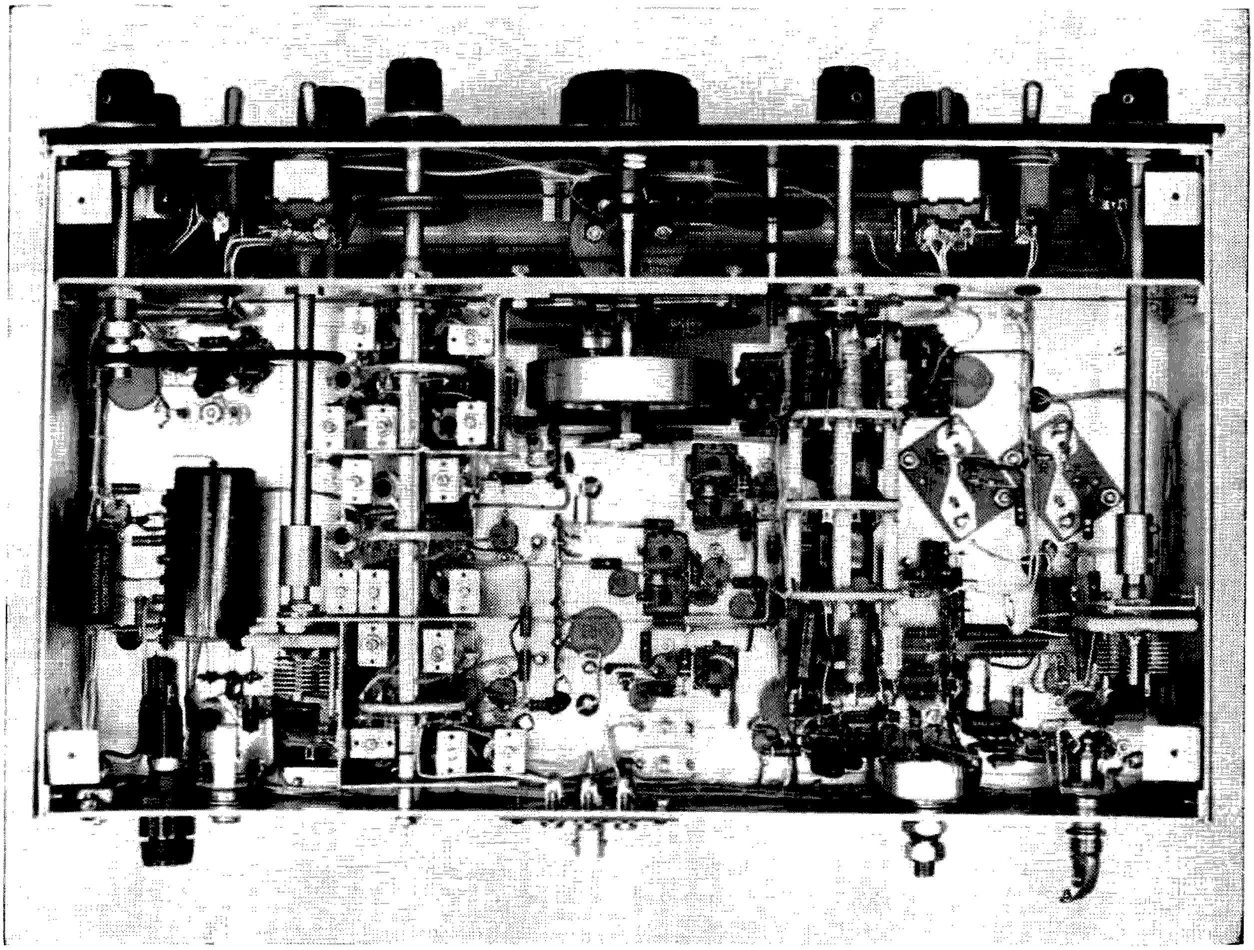


FIG. 3



of the band pass moves up in frequency as the bandwidth is increased. In other words, 85 kc is the center frequency when the bandwidth is minimum, and 88 kc is the center frequency when the bandwidth is maximum. When receiving SSB signals, the carrier insertion frequency is set at 85 kc. For proper reception with this arrangement, both upper and lower sideband signals must appear as an upper sideband signal at the input to the 85 kc *if* strip. For this reason, the second conversion oscillator operates either above or below the first *if* depending on whether upper sideband or lower sideband is desired.

The signal from the 2.2 mc *if* amplifier is applied to the base of Q_5, the second mixer. Oscillator injection is applied to the emitter of Q_5 and its output is tuned to 455 kc, the second *if*. The emitter of Q_5 is biased from a voltage divider in the same manner as Q_1 and Q_4, the other two AGC'd stages.

The output of the 455 kc transformer is applied to the base of the common emitter third mixer stage, Q_6. The output of Q_6 is applied to the double tuned input transformer of the 85 kc *if* strip. Oscillator voltage is injected into the emitter of Q_6 through a secondary winding on the oscillator coil in series with its emitter resistor.

The reception of a single sideband signal on any receiver requires that the signal into the *if* strip be within approximately 50 cycles of its original frequency with respect to the injected carrier in order to properly recover the modulation. This criteria makes the receiver front end setting very critical and on many receivers, it is difficult to properly tune

Coil	Primary	Tap	Secondary	Tap
2.2 mc if	50 T #38	35 T	55 T Litz	1 T
455 kc if	165 T #40	80 T	165 T #40	2 T
85 kc input	525 T #39	260 T	525 T #39	20 T
85 kc interstage	525 T #39	208 T	525 T #39	28 T
85 kc output	615 T #40	212 T	112 T #40	none
2nd conv. osc.	60 T Litz	none	6 T #38	none
BFO	525 T #38	33 T	none	none
100 kc osc.	525 T #38	none	none	none
3rd conv. osc.	167 T #40	59 T	10 T #40	none

Coil forms are Elrad or Radio Industries cup core type. Litz wire is 5/44.

such a signal. This problem becomes more pronounced on the wider amateur radio bands since for equal degrees of rotation of the tuning gang the frequency coverage is increased. For these reasons, it was decided that a "vernier" of fine frequency control would be desirable when receiving single sideband signals. This fine tuning control was realized by making the frequency of the third conversion oscillator variable over approximately a 6 kc range. This allows the 455 kc signal to be converted to 85 kc ± 3 kc so that the incoming signal may be placed anywhere in the passband of the 85 kc *if* strip. Since this control is independent of the front end tuning, the same fine degree of tuning on all amateur bands was realized. This control proved to be particularly useful when more than one station on slightly different frequencies was being alternately received.

The second conversion oscillator, Q_{15}, is a conventional common emitter crystal oscillator. Its emitter resistor was split and left partially unbypassed to provide some negative feedback. This negative feedback serves to reduce the harmonic content of the oscillator injection voltage. The third conversion oscillator is a conventional common base circuit and is tunable over a 6 kc range as previously explained.

85 kc if Amplifier

The variable selectivity 85 kc *if* strip is shown in Fig. 2. It consists of two double tuned transformers and one single tuned transformer used in conjunction with two common emitter amplifiers, Q_7 and Q_8. Variable bandwidth is achieved by changing the Q of the secondary and the coupling between the primar and secondary of the two double tuned transformers. The Q of the secondary is lowered by switching resistors in series with its low end. The primary and secondary are coupled through a common capacitor connected to their low end. The coupling is increased by switching in smaller value common low end capacitors. At the same time, the secondary Q is lowered, the coupling between primary and secondary is increased and the bandwidth is made wider. One distinct advantage of this system is that all switching is accomplished at low impedance points which practically eliminates lead length and layout problems. It was mentioned earlier that the center frequency of the *if* bandpass shifted up as the bandwidth was increased. This occurs because the switched coupling capacitor is part of the tuning capacity for both the primary and secondary windings. This capacitor is reduced as the bandwidth is increased and it causes the center frequency of the bandpass to be shifted. The bandwidth of this receiver was made variable from 1.5 kc to 6 kc in six steps. Narrower bandwidths could be achieved by using coils with higher unloaded Q but again, as in the front end, physical size of the receiver being a design objective limited the physical size and, in turn, the unloaded Q of the 85 kc coils.

To provide minimum insertion loss in the output *if* coil, it was decided to make it single tuned and with a low loaded Q. Minimum loss in this coil provides more available power for AGC purposes. It, therefore, provides very little if any selectivity to the overall response of the *if* strip.

The collector of each transistor is fed into an impedance which enables maximum signal handling capabilities. It can be shown that this impedance is equal to the collector to emitter voltage divided by the collector current.

(Turn to page 90)

Band	Antenna Coils			R F (Mixer) Coils			Oscillator Coils	
	Primary	Secondary	Tap	Primary	Secondary	Tap	Primary	Tap
80m	6 T #38	50uh 68 T Litz	6 T	2 T #38	50uh 68 T Litz	30T	12uh 35 T Litz	3 T
40m	3-1/4 T Litz	4.65uh 28 T Litz	3-1/4 T	2 T #30	4.65uh 28 T Litz	none	2.1uh 17 T #26	2-1/2 T
20m	2 T #26	.75uh 12 T #24	3-1/2 T	3-1/2 T #26	.75uh 12 T #24	none	.47uh 10 T #22	1-1/2 T
15m	1-1/4 T #23	.27uh 6 T #20	2 T	3 T #26	.27uh 6 T #20	none	.20uh 6 T #20	1-1/4 T
10m	1 T #24	.36uh 8 T #21	2 T	2 T #26	.36uh 8 T #21	none	.29uh 8 T #20	1-1/4 T

80m, 40m and antenna and rf coils for 20m are close wound. Others are spaced the length of the form. Trimmers are ARCO 403 except for 15m, which uses ARCO 404. Coil forms are all CTC-PLS62C4L/20063. Use suffix E (red slug) for 80, 40 and 20, suffix D (white slug) for 10m and 15m oscillator and suffix O (green slug) for 15m antenna and rf.

Simplified Transistor Biasing

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Transistor biasing is a subject which has been extensively discussed in many magazines, both amateur and professional. Because the transistor is a non-linear device (that is, E=IR does not hold over its entire range of operation) these discussions have often been quite complex and difficult to apply to real life situations. You may often bypass these difficulties by assuming that the transistor has certain linear properties, using Ohm's Law (and other circuit equations) to calculate the voltages and currents required, and then modifying the circuit when you get it on a breadboard to eliminate those cases where the assumptions didn't quite work. In many cases the breadboard circuit will work exactly as predicted and this last step won't be necessary.

One thing you should remember at the start is that even today, most experimenters transistors (i.e. the CK-722, or the 2N1302) will vary so much from their published characteristics that you might as well not have them. For example, the Beta of a 2N1302 may vary anywhere from a low of twenty to a high of infinity (well, not quite that high, but there is no published upper limit). What to do then? In designing a circuit it's nice to be able to predict what you can expect from it when it is constructed so you will know when you have it optimized. This involves a little mathematics. To be sure, you can avoid the mathematics all together and bias your transistor as shown in Fig. 1. All you have to do is turn the knob on the pot marked Rb until the stage amplifies.

While that is all you have to do, it might be added that it is all you will be doing. Every time you change transistors, or the temperature changes, or some part changes value, or (more than likely) every time the moon changes phase you will find yourself diddling with Rb. This is not a good biasing system.

Fig. 1 is good for one purpose though. Notice the polarities used to bias the transistor. This is an NPN transistor. The collector and the base are both made positive with respect to the emitter. This makes the collector-base junction reverse biased and the base-emitter junction forward biased. This is the normal operating condition for a transistor amplifier. If the transistor were PNP, exactly the opposite polarities would hold but the collector-base junction would still be reverse biased and the base-emitter junction would still be forward biased.

You may wonder how it is known that the collector base junction is reverse biased when the collector supply voltage is connected between the collector and emitter. The answer lies in the fact that a forward biased diode (such as the base-emitter junction) has only a small voltage across it. This voltage has the polarity shown in Fig. 1 and, except for very high temperatures, will have a magnitude of less than a volt. This voltage is commonly designated V_{BE}. Now V_{BE} opposes the collector supply voltage so that the collector-base voltage is V_{CC}-V_{BE}. Since we can keep V_{CC} greater than a volt, the collector-base voltage is positive and this junction is reverse biased.

If this is not completely clear to you think of it this way. Imagine another arrowhead on the transistor symbol, this one on the collector lead pointing in the same direction as the one on the emitter. We know that the base-emitter junction is forward biased since conventional current (which flows from positive to negative) travels through this junction in the same direction as the arrowhead is pointing. The collector is positive with respect to the base which means that conventional current will flow from the collector to the base. This is opposed to the direction indicated by our imaginary arrow on the collector lead so this junction is reverse biased. See Fig. 2.

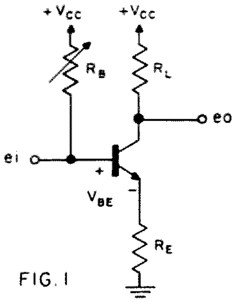


FIG. 1

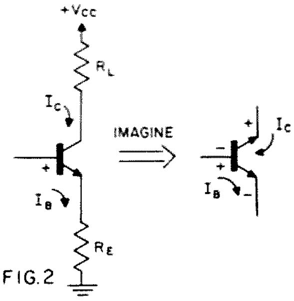


FIG. 2

It was mentioned above that the base-emitter voltage will always be some low value because this junction was forward biased. We can be more specific than this and say that at room temperature (70 degrees F.) this voltage will be about 0.3 volts for a germanium device and 0.6 volts for a silicon device. In designing our circuits we can assume V_{BE} to be constant at one of these values. Which one we choose depends, of course, on whether our transistor is germanium or silicon.

One more assumption and we can get to work. We will assume that the collector-emitter voltage (V_{CE}) of the transistor will be from one-half to one-third of the collector supply voltage when we are designing circuits. It does not matter exactly what this voltage is as long as it is greater than a couple of volts and meets the above requirement.

Using the above assumptions we may design transistor amplifier circuits which will be relatively insensitive to transistor and temperature changes and which may be designed for a specified gain. Actually, what we will be doing is making extensive use of negative feedback in the form of an unbypassed emitter resistor.

Let's first analyze (as opposed to design) a simple transistor amplifier to get a feel for the mathematics involved. All that is required is a knowledge of a few simple circuit equations, like Ohm's and the voltage divider laws.

Fig. 3 is the circuit to be analyzed. Assume that the transistors are germanium and that each has a beta of 100.

First of all, by the voltage divider equation we may find V_{B1}. Assume that the base current is small enough to be ignored (remember we are approximating!). Get out your slide rule and check these calculations if you want to get the most out of the example.

$$V_{BI} = \frac{3.3K}{3.3K + 18R} \times 12v = 1.8\%$$

Now, since this is a germanium transistor we know that the base-emitter voltage of the first stage must be 0.3 volts. Therefore, V_{E1}

must be

$$V_{EI} = V_{BI} - V_{BEI} = 1.87 - 0.32 = 1.5\%$$

We now know the voltage across the emitter resistor in the first stage and may calculate the emitter current.

$$I_{EI} = \frac{V_{EI}}{1.5K} = \frac{1.57_V}{1.5R} = 1.04 \text{ ma, say 1 ma}$$

Since we are assuming that the base current is very small, we may say that the emitter and collector currents are about the same, or $I_{C1} = 1$ ma. Actually $I_E = I_C + I_B$. This is one of the basic expressions of transistor circuit analysis and it is a good one to remember. The drop across the collector resistor may then be computed to be

$$1\text{ma} \times 6.8K = 6.8v$$

and

$$V_{CI} = V_{CC} - 6.8v = 12 - 6.8 = 5.2v$$

This completes the calculations on the first stage. By looking at the diagram you can see that $V_{B2} = V_{C1}$ so that $V_{B2} = 5.2$ volts. We may then find V_{E2} using the same method as applied to the first stage

$$V_{EZ} = V_{BZ} - V_{BEZ} = 5.2 - 0.3 = 4.9v$$

and

$$I_{EZ} = \frac{V_{EZ}}{4.7K} = \frac{4.9v}{4.7K} = 1.02 \text{ ma, say 1 ma}$$

We now have computed all the voltages and currents associated with this two stage amplifier. But what about gain? An exact calculation would involve the use of h-parameters and a lot of algebra. We can come pretty close by the following method.

The gain of any device is defined as the ratio of the ac output voltage to the ac input voltage. Our first stage gain would then be V_{cl}/V_{bl} where the small subscripts indicate ac voltages. Now, we know that $V_e = V_b - V_{be}$ (the same expression as used for dc voltages). In other words, the emitter voltage is always equal to the base voltage minus some constant. If the base voltage goes up, so does

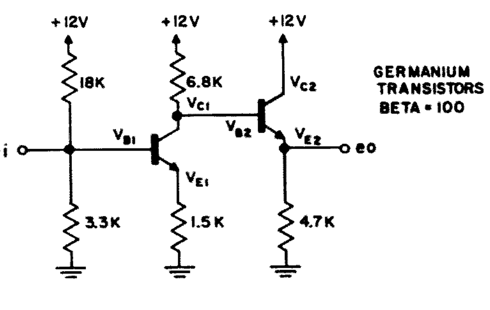


FIG.3

the emitter voltage; if the base voltage drops, so does the emitter voltage. The emitter voltage tends to "follow" the base voltage. This is where the term "emitter follower" comes from.

We may then write the gain expression as V_{cl}/V_{el}. Since the collector current is approximately equal to the emitter current the gain of this first stage must be $R_C/R_E = 6.8K/1.5K = 4.55$. Since the second stage is an emitter follower and has a gain of one (again, approximately) the overall amplifier gain is 4.55 also.

This assumes there are no loading effects from stage to stage. There are loading effects of course, but ignoring them in a case like this will not make you very wrong. The actual circuit gain may be about 4.0.

To get some idea of just how much loading does exist you may use the following expressions which were derived from h-parameter equivalent circuits.

For an emitter follower:

$$R_{in} = \text{beta} \times R_E$$
$$R_{out} = R_B/\text{beta}$$

where R_B is the two resistors of the base voltage divider taken in parallel. In the case of the second stage of Fig. 3, R_B is the collector resistor of the preceding stage or 6.8K. R_{in} does not include the effect of any resistors that may be connected to the base (such as a voltage divider used for brasing). Should any resistances be connected to the base they must be taken in parallel with R_{in}. For regular common emitter amplifier the input impedance is the same os for the emitter follower (approximately). The two resistors of the biasing divider are taken parallel with R_{in}. Often this input impedance will be the same as the lower resistor in the divider. The output impedance of a common emitter amplifier is essentially R_C, the collector resistor.

The input impedance of the second stage of Fig. 3 is then (assuming beta equals 100)

$$R_{in} = 100 \times 4.7K = 470K$$

Before I get some nasty fan mail, let me hasten to add that there is an upper limit to the input impedance that you can get from an emitter follower. This is in the range of 70 to 100K. If your computations yield an input impedance higher than this (as they did here) you may rest assured that you are getting the maximum input impedance possible from your circuit and that it is in the range mentioned before. Remember that these calculations are all approximate and you must take them with a grain of salt. Notice

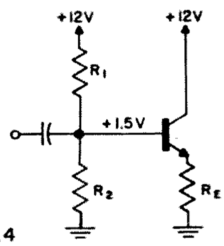
though, that this approximate calculation has told us that the second stage will not load the first. A 70K resistor hung in parallel with a 6.8K resistor will yield a parallel combination of just about 6.8K. This leads to a good rule to remember. Whenever you have two resistors in parallel and one is greater than ten times the other the parallel combination has a value about equal to the smaller resistance. This can be worked downward somewhat so that even if the larger resistor is say, seven times the smaller, the result is still pretty good but you shouldn't go much lower than this.

The output impedance of the second stage (and hence of the amplifier) is

$$4.7K/100^2 = 47r$$

Just as there was an upper limit on the input impedance there is a lower limit on output impedance, somewhere in the vicinity of ten to twenty ohms. You can see we didn't get close to it here.

This completes the *analysis* of this circuit. *Design* is essentially going in the other direction. Starting with desired voltages and currents we work towards component values. Design is not so straight forward as analysis and leans heavily on experience. Unfortunate-



$$V_B = \frac{R_2}{R_1 + R_2} V_{CC} \quad (1)$$

$$R_1 + R_2 = 12\text{K} \quad (2)$$

$$R_2 = 1.5\text{K}$$

$$R_1 = 12 - 1.5 = 10.5\text{K}, \text{ SAY } 10\text{K}$$

FIG.4

ly you can't get experience without designing, you can't design without experience . . . and so on. You can break into this vicious circle without getting too dizzy by applying the approximations we used in analyzing the circuit of Fig. 3.

Let's first of all design a simple emitter follower. You might want to use this circuit between two regular common emitter amplifiers to prevent the second stage from loading the first. This is, in fact, a most common use for emitter followers. The important parameter when biasing transistors from a voltage standpoint (and that is what we are really doing here) is the transistor base voltage. It must be high enough so that the swing of the input signal does not reverse bias the base-emitter diode at any time during the input cycle. Then again, it must not be so high that the transistor goes into saturation at any time during the cycle. We are looking for a middle point.

Assume a 2.0 volt (peak to peak) input swing. If we are using a 2N1302 (which is germanium) we would then have to set the base to at least 1.3 volts, 1.5 volts would be better and 2.0 volts better yet. This will insure that the base-emitter junction will never be reverse biased. Assume that we choose a base voltage of 1.5 volts. This means that the input signal swings between 0.5 and 2.5 volts. If saturation is going to occur it will occur at the 2.5 volt point. When the base is at this voltage, the emitter is at 2.2 volts leaving 12-2.2, or 9.8 volts across the transistor (assuming $V_{CC} = 12$ volts as an example). Since the transistor has some voltage across it it is not saturated (or anywhere near it in this instance). Saturation occurs when V_{CE} is forced to drop to zero volts.

Most of the time an emitter follower just won't saturate. This may seem like a rash statement but it is borne out in practice. It has to do with the fact that for a series of stages all run off the same collector supply the emitter follower stages all have greater V_{CE} than the regular common emitter amplifiers (due to the absence of the collector resistors). This means a higher saturation voltage on the base. If the regular amplifiers are not saturating for a given input signal the emitter followers can't possibly saturate either. At least, not if they are direct coupled as shown in Figure 3.

So we want to put 1.5 volts positive (the 2N1302 is an NPN transistor) on the base. A simple voltage divider will do this nicely as shown in Figure 3. Here is one point where you must rely on experience. Just how much bleeder current do you want to draw through R1 and R2. To make the current too large is wasteful, to make it too small is to ruin our approximations and the stability of the stage. A general rule of thumb might be to make the bleeder current from five to ten times as large as the base current, say, somewhere around one mil. With 12 volts for V_{CC}, this makes the sum of R1 and R2 equal to 12K. Now we can solve the two equations shown in Fig. 4 for R1 and R2. We find that R1=10K and R2=1.5K.

After you've chosen standard value components to use in your circuit go back and compute the actual base voltage to make sure the value you end up with does not cutoff the transistor. In this case the base voltage comes out slightly higher than 1.5 volts so the result is OK. The sum of the two resistors is also quite close to 12K. Next, R_E is chosen from a knowledge of the desired emitter current. Unless it is driving a very heavy load, a 2N1302 will operate quite nicely on under one mil. Assuming I_E equal to one mil, we find R_E to be

$$R_E = \frac{V_B - V_{BE}}{I_E} = \frac{1.5\text{v} - 0.30}{\text{Ima}} = 1.2\text{K}$$

More often than not, you can avoid the necessity of computing a divider by direct coupling the emitter follower to the collector of the previous stage. This is shown in Figure 5. Direct coupling also eliminates the drop in input impedance caused by the low impedance voltage divider. This is the only way to insure that your input impedance will be up near the maximum attainable. The only mathematics necessary in this case is the calculation of R_E since the collector voltage of the previous stage is undoubtedly known.

So much for the emitter follower.

Now let's try to get some gain out of the transistor. It was mentioned before that 2N1302's have betas which run from twenty on up. Most units will have gains in the vicinity of 70 to 100. This means that we would usually be able to get a gain in the vicinity of 50 to 70 from a single stage of amplification. Since we want to be able to use

any 2N1302 picked at random from stock in our amplifier we would do well to limit the gain of each stage to no higher than fifteen. Two such stages would then give us a gain of greater than 200. While it may seem that we are doubling the number of components and transistors required to get a driven gain unnecessarily, what we get in return makes the trade-off worthwhile. It becomes possible to design the amplifier easily (without having to specially select transistors or components) and with an inherent stability not necessarily present in the one stage amplifier. What we are really doing is greatly overdesigning the amplifier and including a large amount of negative feedback. It might be well to remember that, in general, the greater the amount of negative feedback incorporated in a design, the more insensitive it will be to circuit parameter variations. At the prices that experimenters transistors are available for these days (even brand new 2N1302's go for 50 cents each; 33 cents each if you are willing to buy 100) this approach to design becomes economically worthwhile.

Let's design a single stage of amplification with a gain of ten. We know from our analysis of Fig. 3 that the gain of such a stage is approximately R_L/R_E. Or, in this case, R_L must be about ten times R_E. Fig. 6 shows the circuit diagram of the stage. The transistor to be used is a 2N1302. It is normally a good idea to make V_E from five to ten times V_{BE} to minimize the variation of base voltage with temperature (as V_{BE} drifts) but in this case even using the factor of five would lead us to an unreasonably high collector supply voltage

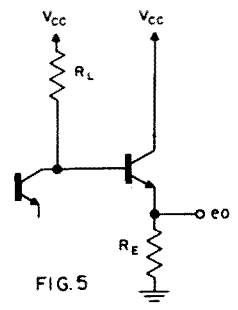


FIG. 5

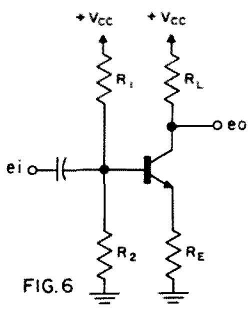


FIG. 6

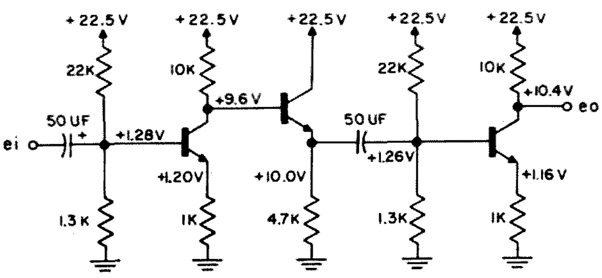


FIG. 7

so a V_E of 1.0 volts was selected. Since the collector and emitter currents are almost equal this means that we must have about ten volts across the collector resistor. Putting 11.5 volts across the transistor (V_{CE}) and adding them all up gives 22.5 volts for the collector supply, which is a reasonable value (and convenient!). You should notice that the collector-emitter voltage chosen here is just about one-half V_{CC}. If we take a collector current of one milliampere (a reasonable number) we find $R_L = 10K$ and $R_E = 1K$. See Fig. 7.

Next we compute the base voltage divider in the same manner as for the emitter follower. In solving for R1 and R2 we obtain R2 = 1.3K and R1 = 21.2K. For standard components, we might use R2=1.3K and R1=22K. This divider will give you a base voltage of about 1.25 volts.

Let's now investigate the allowable voltage swings. We already know that in the negative direction a swing of 1.25-0.3=0.95 volts is allowed. As long as we do not exceed this negative swing, the base-emitter junction will remain forward biased and the transistor will not cut-off. But what about the other direction? How positive may we allow the base to swing?

Remember that under very large positive swings, the transistor will saturate causing V_{CE} to go to zero. The point at which this first occurs determines our limit. The positive swing must not be so great as to force the collector-emitter voltage to drop to zero. This maximum base swing may be found as follows. Assume that the transistor V_{CE} has gone to zero, we then have the 22.5 volt collector supply divided across the 10K collector load and the 1K emitter resistor. Treating this like any voltage divider tells us that the emitter voltage is

$$V_E = \frac{1K}{11K} \times 22.5v = 2.05v \text{ when } V_{CE} \text{ is zero.}$$

The corresponding base voltage is then

$$2.05 + 0.3 = 2.3v$$

which means that the base may swing positively a total of

$$2.34 - 1.25 = 1.15v$$

We see that in this case the allowable positive and negative swings are approximately equal. Since the negative value is slightly smaller than the positive, it controls and the allowable peak to peak swing is 1.90 volts. If, in designing your amplifier, you wish to make the swings more nearly equal you can go back and reset the base voltage (by changing the base voltage divider) to accomplish this. It's most easy to do this when you have the circuit breadboarded.

As with most circuit problems, you can of course approach this from the other direction and from a known allowable swing calculate the required base and supply voltages required. The process is the same. In all cases nothing more than the simplest of circuit formulas is required.

We now have a single stage amplifier with a gain of ten providing it is driven from a real low impedance source and feeds a real high impedance load. Any load lower than about 100K will cause the gain to drop since the effective R_L drops. This is fine if all you want to do is feed some high impedance device—like the input of a scope. But suppose you wanted to cascade two of these stages to get a gain of 100? You could go back and redesign the first stage for a new effective R_L and increase the collector supply, but there is an easier way out. Just put an emitter follower between the two stages. The high input impedance of the follower will prevent loading of the first stage by the second and at the same time provide a low impedance source to drive the second stage. This will not eliminate all the loading effects but it will help sufficiently to get the overall gain up close to 100. You can direct couple the emitter follower to the collector of the first stage (in fact you must if you are to get maximum gain) but should ac couple the follower to the second stage, like in Fig. 7.

If you calculate the gain of the three stage amplifier using h-parameters you will find that the gain may vary from 60 to 177 depending upon the particular transistors used. Since most 2N1302's have betas in the 70 to 100 range, it would not be unreasonable to expect an overall gain in the vicinity of 100. The overall gain of a two stage amplifier (no emitter follower for isolation) may also be computed to be between 9 and 22.

The author has constructed the circuit of Fig. 7 (with and without emitter follower isolation). The resulting dc voltages (not signal applied) are shown near the corresponding transistor elements on Fig. 7. Notice that they are very close to the predicted values with one exception. The emitter of the emitter follower is apparently more positive than the base. This cannot be. The error is due to reading the base voltage with a 20,000 ohms/volt meter. A VTVM should be used.

AC gain measurements were made using an audio oscillator at 1 kc as the signal

source. In each case the input level was adjusted so that the output waveform just began to clip. For the first stage alone 18 volts peak to peak was obtained with an input signal of 1.85 volts (p-p), giving a gain of 9.72. The second stage came out almost as nice, yielding maximum output voltage of 17.0 volts (p-p) for an input of 1.80 volts (p-p). This corresponds to a gain of 9.46.

The two stage amplifier without the emitter follower gave a gain of 9.89. With the emitter follower included a gain of 91 was obtained for 15 volts (p-p) output and 0.170 volts (p-p) input.

You will notice, of course, that we could not predict the exact gain of the composite amplifier. Please take note of the fact that we did come close, though.

That about wraps it up. The author makes no claim for having originated this design procedure. It is fairly common knowledge among circuit design engineers but it is not often seen in print. Usually techniques of this type are passed along by word of mouth. The author learned the procedure while working on his Masters thesis at Oklahoma State University and owes much to the faculty and his friends at that school.

The techniques described in here are really only the beginning of a far reaching design technique but much can be learned by applying them. May you find them very useful.

. . . K2HQY

All transistors 2N1302

Voltages shown are measured dc values—no signal applied, taken with a 20,000 ohm/volt dc voltmeter.

REFERENCES

Transistor Circuit Design; Texas Instruments Incorporated McGraw-Hill, 1963, Chapter 7 and 8.

Transistor Circuit Analysis; Joyce and Clark, Addison-Wesley, 1961.

Letter

Dear Wayne:

Would like you to print in either "73" or "6 Up" magazine, the fact that the East Coast VHF SSB Association is still offering a trophy for the first Ham to work 48 states on 6-meter single sideband.

The present band opening season, now in effect, has reawakened considerable interest among the sideband operators. A good number of the "rare" states are being heard. No award like this has ever made, and we think it would be an honor to the Ham who can win it.

We now have a call list of 267 Sidebanders in the New York to Washington, D. C. area, and we are certain there are 75 more operators, whose calls we have not marked on our list.

Abraham Z. Cutler, WA2ONB
Secretary-Treasurer

Transistors for Ham Use

Paul Fronson WA4HWH/WA1CCH

When the ham decides to build some transistorized equipment, he has two choices ahead of him. He can copy someone else's work (such as articles in this issue) or he can try to design his own. The ham magazines have had many helpful articles and various books and handbooks will also prove invaluable, but in the choice of transistors the ham reaches a stumbling block. There are an incredible number of semiconductors available—So which one to use? The transistors listed are suitable for most ham communications uses. We recommend that you pick a transistor for each application and concentrate on these transistors. Then you'll learn the characteristics and possibilities of the transistors thoroughly and keep your stock (and expense) down.

In case it sometimes seems that many semiconductor manufacturers are not interested in hams and their equipment, remember that the big money is in government and industrial applications. Don't judge the manufacturer too harshly. However, all the semiconductors listed are made by manufacturers who have shown interest in amateurs; we heartily recommend that you use their products. Remember that most transistors now made are designed for switching and other computer applications, but notice that Amperex makes a complete line of high quality communications transistors at very moderate prices. Motorola, T.I. and others likewise.

One other hint—Newark Electronics in Chicago is one of the few mail order distributors that issues a combined industrial-amateur catalog. Many of these transistors are listed only in industrial catalogs, so it is recommended that you get the Newark catalog. They carry all of the semiconductors listed. Be sure to mention 73 when you write.

Application Notes

The following list of transistor application notes are of particular interest to hams. These booklets are generally fairly technical and

(Text continues on page 64)

Trans	Mfg	Price	Case	V_{CB}	$I_C$ma	$P_C$mw	$h_{fe}(h_{FE})$	$f_T(f_{hfb})$	Gain in db @ f	Remarks
UHF AMPLIFIERS AND MIXERS										
2N1742	Sp	2.93	TO-9	20	50	60	(33)		14-19 @ 200mc	f max 980 mc NF5.5db
2N2360	Sp	2.40	TO-12	20	50	60	(33)		ditto	ditto
2N2495	Am	2.36	TO-33	35	10	100	70	(180)	15.5 @ 200mc	4 db NF @ 200mc
2N3283	Mot	2.10	TO-18	25		100	(10)	400	20 @ 200mc	4 db NF @ 200mc
162T1	GE	1.36		14		80	(15)	360	18 @ 200mc	5 db NF @ 200mc
TI-390	TI	2.04	TO-12	30	25	75	(10)	450	12 @ 100mc	NF 2.5db at 200mc
2N1743	Sp	2.87	TO-9	20	50	60	(33)		14 @ 200mc(conv)	Mixer
2N2361	Sp	2.25	TO-9	20	50	60	(33)		ditto	ditto
2N3284	Mot	2.02	TO-18	25		100	(10)	400	20 @ 200mc	Mixer
TI-391	TI	1.85	TO-12	30	25	75	(10)	450		Mixer
UHF OSCILLATORS (Note that all of the amplifiers and mixers may also be used)										
2N502	Sp	2.90	TO-1	20	100	60	65		8 @ 200mc	Gen Purpose f max 500
2N1744	Sp	2.25	TO-9	20	50	60	65			1.5mw out at 257mc
2N2362	Sp	2.10	TO-12	20	50	60	65			like 2N1744
2N3285	Mot	1.80	TO-18	20		100	(10)	400		osc to 2000mc (f max)
2N3293	Mot	1.80	TO-18	20		200	(10)	600		NPN Silicon f max 2000
VHF AMPLIFIERS (Note that all the above transistors will work even better at VHF than at HF)										
2N2084	Am	1.34	TO-33	40	10	125	100	(100)	14 @ 100mc	"Universal RF trans."
2N2671	Am	.84	TO-12	32	10	100	150	(100)	14 @ 100mc	
160T1	GE	1.18		14		80	(15)	345	G_p 25 @ 100mc	f max 1000
HF AMPLIFIERS, MIXERS AND OSCILLATORS (VHF and UHF transistors may also be used)										
2N1745	Sp	1.81	TO-9	20	60	50	(33)		21 @45mc	f max 500
2N2189	TI	1.64		40		125	135	(150)		
159T1	GE	1.14		14		80	(15)	330		
TI-365	TI	1.50		30	50	150	(30)			RF amp
TI-395	TI	1.41		30	50	150	(30)			Oscillator
10.7 mc IF										
2N1865	Sp	1.10	TO-9	20	50	(60)			25-31 @10.7mc	
2N2654	Am	1.42	TO-12	32	10	100	50	(250)	19 @ 100mc	
155T1	GE	.62		12		80	(20)	150	G_p 35 @ 10.7	
BC AMPLIFIERS, MIXERS, OSCILLATORS AND IF'S										
2N1726	Sp	1.15	TO-9	20	50	60	(40)		35 @ 1.6mc	RF amp f max 100
2N1727	Sp	1.00	TO-9	20	50	60	(15)		35 @ 1.6mc	Mixer f max 100
2N1728	Sp	1.10	TO-9	20	50	60	(25)		40 @ .455mc	Oscillator-if amp
2N2672	Am	.67	TO-39	32	10	100	150	(75)	8 @ 100mc	
TI-364	TI	.78		30	50	150	(20)			
LOW LEVEL AUDIO										
2N1274	TI	.69	TO-5	25	150	150	(30-150)			
2N2428	Am	.56	TO-1	32	100	500	130	1.7		high gain
2N2429	Am	.57	TO-1	32	100	500	220	2.3		very high gain
2N2431	Am	.57	TO-1	32	300	360	63			NPN
HIGH LEVEL AUDIO										
2N456B	TI	2.50	TO-3	40	7 A	150 W	(30)			
2N555	Mot	.75	TO-3	30		40W	50			
2N1038	TI	2.85	TO-3	60	3 A	20 W	(20)			
2N2431	Am	.62	TO-1	32	1000	1000	90			
TRANSMITTER OSCILLATORS AND AMPLIFIERS										
PADT50	Am	5.00	TO-3	70	700	6W	40	120		
2N741	Mot	2.18		15		150	(10)	360	22 @ 30mc	
2N2084	Am	1.34	TO-33	40	10	125	100	(100)	14 @ 100mc	
2N2512	Am	1.50	TO-33	70	50	260	200	175		
2N2786	Am	4.65	TO-39	34	150	1000	80	350	10 @ 80mc	.57watts out at 80mc
2N2957	Mot	4.50	TO-5	60		3000		400	NPN Silicon	.6 watts out at 50mc

GENERAL PURPOSE VARACTOR

1N3182 Am .82 solder-in P_o 163 mw VR 20 v C @ -4 v: 33mmf Q @ 50 mc: 65

TUNNEL DIODES

1N3716	GE	2.55	I_p 4.7ma	V_p 65mv	-G 40 x 10^{-3}mho	TD-3
1N3718	GE	2.55	I_p 10.0ma	V_p 65mv	-G 80 x 10^{-3}mho	TD-4
1N3720	GE	1.80	I_p 22.0ma	V_p 65mv	-G 180 x 10^{-3}mho	TD-5

Am: Amperex; GE: General Electric; Mot: Motorola; Sp: Sprague; TI: Texas Instruments

most do not give specific circuit information on coils and layout. Magazine articles and handbooks will provide more information useful to the beginner. Nevertheless the notes are very informative and of great help to the serious experimenter. However they are very expensive for the manufacturer to produce. Study the handbooks before you send for them and be sure to mention 73 when you write—but don't kill the golden goose by requesting information that is not useful to you.

John Miller, Tech Publications Manager
Texas Instruments
Semiconductor Building
13500 North Central Expressway
Dallas, Texas

VHF transistor power stages
200 mc noise figure measurement
Transistors in UHF-TV tuners
Amateur communications receiver

Sidney Chertok, Manager, Advertising and Sales Promotion
Sprague Products Company
North Adams, Massachusetts

Short form catalog CN-116F
2N1742, 3, 4 and 2N2360, 1, 2, in VHF amplifiers and mixers. 38,020.
45 mc if amplifier using 2N1745 and 2N1868. 38,021.
MADT transistors in AM radio applications. 38,018.
MADT transistors in 4.5 and 10.7 mc if amplifiers (also includes a simple all-wave communications receiver). 38,022.

Rarrell Thorpe, Tech Communications Supervisor
Motorola, Inc.
P.O. Box 955
Phoenix, Arizona

Modulation techniques for transistorized AM transmitter. Report 82
50 mc transmitter using the 2N2947. Report 99.
2 watt output at 160 mc using the 2N2950. Report 100.
CB transmitter using the 2N2950. Report 101.
2N741 as a power oscillator and class C amplifier. AN 124.

M. Smoller, Manager, Advertising and Sales Promotion
Amperex Electronic Corporation
230 Duffy Avenue
Hicksville, L. I., N. Y.

Condensed catalog (Includes some circuit diagrams)
2N2495 in mixer at 170 mc. S-103
(465 mc) receiver using the 2N2495 and 2N2084. UHF S-105
FM tuner using 2N2089 (2N2671) and 2N2495. S-106
10.7 mc if strip and ratio detector. S-110
VHF power amplifiers at 200 mc using the 2N2786. S-113
Low noise 200 mc rf amplifiers using the 2N2495. S-114
Power output of parallel 2N2786 at 235 mc. S-115

The Amperex notes are unique in giving very complete information on coils. They even give layout in a few cases; for instance, S-110 tells you how to wind your own 10.7 mc if coils and S-105 gives information on a cavity filter for the front end.

Modifying the Vanguard Transmitter and Converter

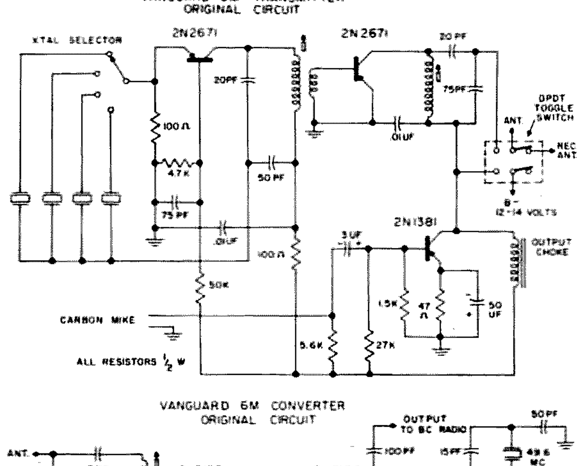
To those who have not purchased a Vanguard 6M transmitter and converter: they don't know what they are missing. See their ads in any old 73.

The transmitter is a 50.5 xtal oscillator using a 2N2671 transistor feeding a final, using another 2N2671 collector (plate to those who compare transistors to tubes) modulated.

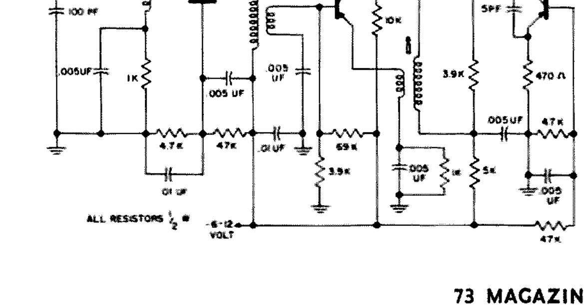
We had a Texas Inst. 2N1143 transistor which we stuck in the final and guess what? We about doubled our rf output, but the modulation was down. We added another stage using a 2N188 and the modulation was good. There isn't enough gain for a xtal mike with the present circuit. A 2N107 and a CK722 was tried but they were a little mushy with the circuit used.

A small 6 transistor radio was obtained (the little Jap jobs about the size of a cigarette package can now be bought very cheap at sales or as damaged goods at the retail stores. I bought ten for 50 cents each). A small break in the printed circuitry or a loose part was all that was wrong. I took the set out of the case and mounted the radio, converter and transmitter plus 8 flashlight bat-

VANGUARD 6M TRANSMITTER
ORIGINAL CIRCUIT



VANGUARD 6M CONVERTER
ORIGINAL CIRCUIT



W. G. Eslick KØVQY
2607 E. 13th.
Wichita 14, Kan.

teries size C, a mike jack and an on/off switch in a metal case that was in the junkbox. I mounted a handle on the case to carry it. A coax connector was mounted on top for outside antenna or whip.

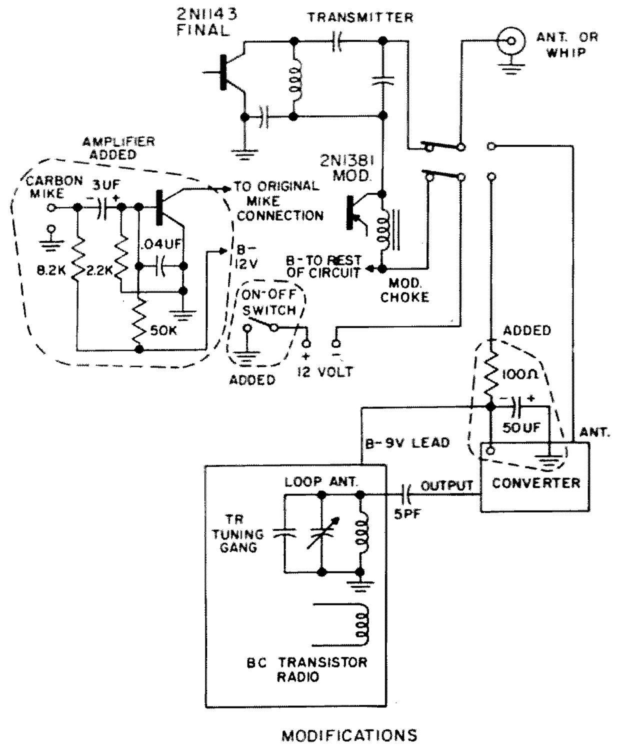
A decoupling and voltage dropping resistor of 100 ohm by-passed with a 50 mfd 15V condenser supplies the converter/receiver with slightly over 8 volts.

The Vanguard transmitter comes with 4 xtal sockets and a selector switch (4 channels) and an on/off-xmitt-rec. switch. I removed all xtal sockets but one, and the selector switch, as they were not used.

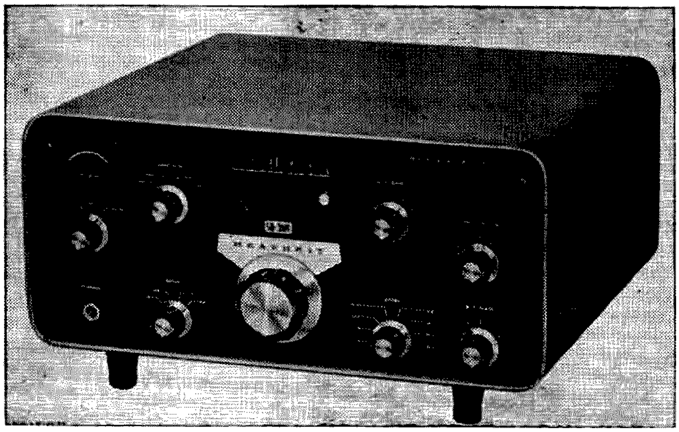
They recommend wrapping a few turns around the loop antenna of a bc radio, grounding one end and connecting the converter to the other. I had the best luck of connecting a 5 mmfd from transistor mixer collector to the antenna side of the tuning condenser in the bc set.

Being mounted inside of a metal case, I had only two feedthru bc stations, one high powered local and the other local about three miles east of QTH.

In all, I am very well pleased with Vanguard's little gems. Need a linear now!!!



MODIFICATIONS



Charles Leedham WA2TDH

The Heath SB-300 Receiver

One of the first things that is bound to hit any ham looking at Heath's new SB-300 is the fact that it looks startlingly like another well known receiver which shall here be known, in the manner of certain sneaky TV commercials, as "Brand C." At least in the black-and-white catalog and pictures it does. In living color, things are slightly different, what with a dark green front panel. Question: does it do more than just look like the high-priced spread? Does it work like Brand C? Answer: as far as my ear and limited supply of test equipment can tell, it does.

In short, Heath has come out with a fair wowser of a ham receiver at the relatively modest figure of $265. It not only works good like a ham receiver should, but a few extra bits of good thinking have been thrown in. The only thing I'm not at all sure of is why the Benton Harbor gentlemen made it look so very much like—and there let us abandon all subterfuge—the Collins line. Perhaps this is the best of all possible ways for a ham receiver to look—I tend to agree with this sort of thinking. Or perhaps Heath was boldly inviting comparison. If so, they didn't do wrong, for the comparison by no means hurts them.

To the necessary formalities first, however. The SB-300 is a full-coverage receiver, designed primarily for SSB, with CW and AM as is, or even better if you add filters for each mode at $20 per. It tunes eight 500 kc band segments, into which the amateur bands fall with a good many kc left over here and there: 3.5-4, 7-7.5, 14-14.5, 21-21.5 and 28-30 megacycles.

One of the very good features of the SB-300 is the fantastic bandspread. One complete turn of the circular main dial is worth 100 kc, and it takes five turns of this dial to work your way across the half-megacycle of band provided in each of the band positions. With the main dial 12 inches around, this works out to five feet of bandspread per half-megacycle. Imagine a linear dial covering 80 meters, with the pointer moving along a five-foot-long scale between 3.5 and 4.0, and you get something of an idea of how finely and accurately the SB-300 can be tuned for SSB and CW.

As the main dial goes around, an ingenious spiral mechanism inside moves a pointer across an upper scale, thus enabling you to keep track of where you are in the band. The actual tuning knob is verniered, with 4¼ turns per 100 kc—thus you can really zero in on a signal, even if you're as hamhanded as I am. It needs no delicate jiggery and pokery to do fine tuning on the SB-300.

Along with this wide bandspread goes Heath's inear Master Oscillator, a precision bit of business that means just what it says—linear. The specs claim electrical dial accuracy of 400 cycles from one end to the other, on any band. As nearly as I can tell, it is that good or better. Once you have calibrated the dial against the built-in crystal calibrator, this means that when you tune to a spot, you are there, or so close as makes no difference. No more trying to remember which spots on your dial mean approximately what they say—ask someone to meet you on a given frequency, tune the receiver to that spot and, if his transmitter is as accurate, there he comes, right at the setting. If another operator asks you to listen for him 5 kc higher, you move the dial up five notches, and you are positively

5 kc higher. This is the kind of operating ease you get with first-class equipment.

Back to the essentials: the SB-300 has an all-crystal front end, variable ACG control, a very high frequency *if* (3395 kc) for good image rejection, excellent sensitivity—the specs say less than one microvolt for 15 db S + N/N ratio, and it tests out at about that.

Construction of the kit is basically straightforward and easy, although it takes time. The LMO is pre-built and sealed, taking that job off your hands and assuring factory-aligned accuracy. All you do is bolt it in place and solder on a few leads. Also the pass band filter, and the *if* filter or filters. Most of the work is done on two circuit boards, the rf and *if* sections.. It is no cinch, for there are are an unbelievable number of resistors and capacitors to be put into the boards, but everything goes step by step. Total construction time is on the order of 40 hours if you're experienced at doing kits; probably about 10 hours more if you're not. In any case, you've got a good week of evening work cut out for you, going at it fairly steadily. After the parts are all in place, there is a pre-cut cabled wiring harness for making the major hook-ups from section to section, which removes a great deal of the pain of construction.

When tune-up time finally comes, everything is made easy and precise by tuning against the 100 kc crystal calibrator. All the tunable coils are gathered in one handy spot and—here another good idea—the whole top of the cabinet lifts up and back on a piano hinge, giving you easy and immediate access to the coils. Also, to find out where you soldered things wrong that are making the fuses blow, the whole chassis slips right out of the cabinet with the loosening of only a screw or two, thus saving you much sweating and cursing.

In operation, the SB-300 is a top-notch receiver. The 2.1 kc crystal filter for SSB gives good sharp characteristics, and with that long, long bandspread SSB is remarkably easy to tune. Frequency stability is very good, less than 100 cycles claimed in the specs, and easily that good in practice. Also, even with the wild fluctuations made by the voltage here in Manhattan, the frequency stays remarkably stable.

Because the SB-300 is a very specialized receiver, nothing happens when you turn the mode switch to CW or AM, unless you have popped for the extra crystal filters for those nodes—a 400-cycle unit for CW and a 3.74 kc for AM. You can, of course, tune CW in the SSB position and also AM. Still, it was a

revelation to me to listen to CW with the proper filter installed. There is the usual hollow, ringing sound of such a narrow filter, but once a CW signal is centered in that filter, there it is, with no nonsense about it. It sounds like suddenly everybody else went off the air. That knod of filter requires the stability that comes with the SB-300, and to anyone—like me—accustomed to trying to copy CW while the note wobbled and other nearby stations faded in and out and made everything miserable, it was startling to be able to catch a signal, and then sit back to copy it with ease.

Only the AM filter seems relatively useless. AM comes in very nicely with it, but it is of little consequence when you can also tune AM just as well in either of the SBB mode positions. About the only thing it does is enable you to listen to Radio Moscow more clearly as it smears the 40-meter band. It also seems futile to have a specialized AM filter when Heath's companion transmitter the SB-400, has no provisions for AM transmission.

The SB-300 is naturally intended for use with the SB-400 transmitter (just out recently, at $325 for an all-band 180 PEP rig), and it is possible to arrange your inter-unit wiring to make one oscillator work for both receive and transmit, thus working transceive with dead-on accuracy. Or you can operate them separately for DX work. The SB-300 works, of course, as well with any other transmitter, except for the transceive feature. There is also provision for operating the SB-300 with two VHF converters, permanently hooked up and switchable-to without a lot of hooking and unhooking. An auxiliary power plug supplies juice to the converters and the converter outputs feed right into the back of the receiver, into special sockets.

All in all, the SB-300 is a very good rig, more than worth the money if you want to do serious receiving.

. . . WA2TDH

Is it Time for a Change?

A. David Middelton, W7ZC/W5CA
Associate Editor
The Monitor
Box 303 Springdale, Utah 84767
Reprinted from June 1964 *Monitor*

In this long hot summer of 1964 the nation is plagued not only with national and state elections but due to ARRL's inept policy—the ARRL elections for Director and Vice Director must be held in eight divisions.

ARRL By-law 18 states that half the divisions shall elect officers each year. This article refers to "Director" only but election rules include Vice Director also. Altho he is an elected official, an ARRL Vice Director is a political non-entity and because ARRL will not permit any voice in the conduct of ARRL affairs, he is as useless as a fifth wheel!

This year the following divisions will hold elections. Incumbents are named along with their divisions.

Central (Haller—replaced Doyle in mid-term 1963); Hudson (Kahn—elected in 1958. He stated at 1964 Board meeting he would not run this fall as he is moving to Florida. This writer will lay odds that Kahn will show up as a candidate from SE Division in a future go-around.) New England (Chaffee—elected prior to 1957); Northwestern (Roberts—elected in 1948); Roanoke (Anderson—elected prior to 1957); Rocky Mountain (Smith—elected in 1960); Southwestern (Meyers—elected in 1958); and West Gulf (Best—elected in 1960). Each of these men took office on Jan. 1st of the year following election except Haller who replaced Doyle in mid-term.

Regardless of the inanity of ARRL's policy of electing officers for a two-year term, every ARRL member owes it to himself, if to no other reason, to select and elect qualified parties to the Directorship.

By-law 13 states that on any date not later than noon of the 20th day of September of an election year in any electing division, nominating petitions signed by TEN or more FULL members of a division, and naming a FULL member of the division as candidate for Director (and Vice Director) may be filed with the Secretary. Petitions are also solicited by notices placed in August and September QSTs.

Far too often an incumbent is returned to office, by default, without ballotting due to one or several "incidents."

His name may be the only one submitted.

If no petition is filed, the request for petitions is repeated three months later, and then if no nominee is named the incumbent returns to office until the next regular election for that division.

Candidates named in petitions may be declared "ineligible" by the ubiquitous Executive Committee. Ineligibility may be ruled due to a candidate not having the required four years membership in ARRL (altho Article 12 does not state when this four-year period is dated). A candidate may be ruled ineligible due to his vocation (Article 12 again) or he may not have a General Class (or higher) license (By-law 8).

The following inconsistency is noted. Petitions are receivable until noon Sept. 20th. By-law 14 states that the Executive Committee shall delete the name of any nominee—who may be ineligible, and the name of any who may withdraw by written communication. By-law 14 does not state WHEN such action by the Executive Committee shall be taken. It is therefore assumed that it occurs AFTER noon, Sept. 20th, which makes it impossible for a group of ARRL members to submit another petition to replace that of an "ineligible" person!

Also, no procedure is defined where anyone can challenge the ruling of the Executive Committee on this important matter. So—in the case of an "ineligible" candidate—he is OUT, unless he wishes to take it to court. Only one party did this. Some time ago a court suit was filed, hearings held (of all places, in Hartford) and the court ruled against Candidate JOHN from Maryland or Virginia.

One type to avoid is a candidate who will permit his name to be entered in nomination, and after it is too late to do anything about it—follows the dictates of the Pressure Group and withdraws his name from nomination. This is a common trick used to confuse and defeat any group seeking to replace an incumbent by another director. Often it serves to return the incumbent, sans vote by the membership!

By-law 14 further states that if there be more than one eligible nominee, the Secretary shall send by mail (during the first week in October) a ballot to each FULL

member (holder of any valid Amateur license) of record as of Sept. 20th. However, due to the poorly-managed mechanics of ARRL, whereby membership and subscription to QST are tied together many drawers of Addressograph plates are "out for processing" at any given time, and therefore a sizable percentage of FULL members do not receive a ballot.

NOTE—if you are a full member of a voting division and do NOT receive your ballot by October 15th you should request one, in writing from the Secretary. Or else you will lose your only opportunity to vote, and must then wait two years for the next.

Ballots are returned to HQ and must be received there by Noon, Nov. 20th. Sometime after that date and time, the count of ballots is held and the election completed.

Here are the steps, in chronological order, that must be taken to replace an incumbent or to fill a vacancy with a new director.

1. Seek and find a politically-qualified person willing to seek the office and to SERVE as Director (or Vice Director).

2. Ascertain his views, on past and present ARRL problems and all matters pertaining to Amateur Radio. His opinions should be obtainable in writing!

3. Certify by examination of records that he has been a FULL member of ARRL for at least FOUR consecutive (unbroken) years and that his ARRL membership is valid at least until January 2nd of the next year. Examine his membership certificates or write to the Secretary (who will refer the matter to the QST Circulation department) for verification and certification.

4. Ascertain thru his records that he holds at least a GENERAL class license valid thru Jan. 2nd of the next year.

5. Prepare and circulate for signature, a petition bearing the legible names and addresses and calls of at least TEN FULL members of ARRL, whose subscription-membership dates are valid at least until November 20th of that year.

6. Mail this petition, via registered or certified mail, with return receipt requested, so that it will reach ARRL HQ at Newington, Conn. well *before* noon, Sept. 20th. Petitions can be mailed anytime now. A deadline for mailing should be set at not later than SEPT 10th!

7. For further insurance, have prepared another petition, with the same name for candidates, but with a completely different set of FULL ARRL member signers. The presence of the same signature on two petitions would automatically invalidate BOTH petitions.

Take every precaution to have at least TEN signa-

tures. A minimum of 12 or 15 is a safe-guard. QST-readers who are NOT full members are NOT legally acceptable.

This writer would like to make it perfectly clear that the ARRL policy-makers and power-political clique will take every opportunity to confuse, to declare ineligible, and to defeat ANY candidate who seeks to un-seat a "desirable" director who is in favor. Any candidate who appears to be a non-conformist to the ARRL Party Line or who might become a factor opposing their schemes will likewise get the full treatment in an attempt to knock him off before he can become a threat to their plans!

Not only must the written rules be observed but every effort must be made by any group seeking to enter a candidate to counteract the unpredictable and unrefutable actions of the and unassailable actions of the Executive Committee in its rulings on eligibility!

The worst act is to permit an inept and bungling incumbent to be returned to office without voting by the membership, by not filing a petition for a candidate to oppose him!

The second worst act might be to present a candidate who will not permit his name to be placed in nomination or who is ineligible, according to the written rules, as confusing as they may seem!

A genuine sin is to return a director who has *proved* his ineffectualness thru his reactionary thinking, lack of action and his indifference to the wishes of his divisional members regarding national ARRL policy or matters pertaining to Amateur Radio in general.

Sentiment or longevity in service has NO place in the selection of an ARRL official, unless such devotion is due to this officer having rendered the *highest possible service to the Amateur body!*

If you wish to determine and to know the actual views or actions of any incumbent, read and study the minutes of the past Board or Committee meetings on which he has served. Board minutes appear in July issue of QST, each year. These minutes are the only *direct* reflection of the incumbents views and actions that he took or did not take during the past year or years he has been in office! He stands or falls on his record—at the Board meeting!

As to the political promises of a candidate seeking the Directorship, that is a far different matter. One should make every effort to determine a candidate's views, in writing, on problems and programs affecting Amateur Radio particularly at the national policy level.

Is the candidate known for his militant acts, thoughts and statements concerning issues of importance or is he merely seeking a couple of free rides to HQ?

Will the candidate, if elected, follow the dictates of his membership and faithfully report on his action and on matters of general interest or will he ignore his constituents after he is elected.

The time to determine all this is BEFORE he is elected. After Jan. 1st of the next year, when he takes office he can and often does simply ignore the rank and file and throw his weight around as a Director without actually ever *doing* anything. This writer refers you to his thought-provoking article in May 1964 *Monitor* entitled "To Act is to Be Committed," an analysis of the 1964 ARRL Board meeting.

Such decisions are necessarily made by each individual ARRL member and thought should be given NOW to the desirability of a change in *your* division. By the time this is in print, less than 60 days will be left in which to place a name in nomination.

Study of the Board meetings of recent years will reveal the *overwhelming necessity to completely change the attitude and posture of the ARRL BOARD.*

This can be done in 1964's election! It is up to you. If you want a change—you can elect a man to *represent* you and your division, and thus, all of Amateur Radio. If you are *satisfied*—then you have read this article for naught.

The Q of an ARRL Director

Here are a few guide lines, which if followed, will give some indication of the Q (Figure of Merit) for either an incumbent or one seeking the office for the first time. These criteria hold for Vice Directors as well as for Director. While the Vice Director may never have an opportunity to DIRECT, he is a "back-up" man if the Director dies, resigns or is kicked out.

1. What does Mr. Candidate *really* think about Amateur Radio? Has he a genuine interest in the aims, goals and meaning of our hobby-service? Has he clearly demonstrated his interest by participating in various phases of Amateur Radio? Does he hold awards (other than for DX) certifying to his achievements?

2. What does Mr. C. really KNOW about Amateur Radio. What class licensee is he? (He must have at least a General to be eligible for office.) Often a person's genuine interest is shown by the amount of effort one makes to achieve personal peak-performance, without any external incentive. How far has Mr. C. gone to achieve an Extra Class, by examination? What are his views on "incentives?"

3. Is Mr. C. a push-button appliance-type operator; can he do no more than change a fuse in his equipment? Has he actually constructed equipment, from scratch? from kits? Has he a well-rounded technical background in Amateur Radio? Has he a working knowledge of the problems of SSB, VHF, CW, AM and antennas? His status as a licensee is indicative of his progress together with his experience as an Amateur.

4. Is Mr. C. a well-skilled operator? Handy with a key or mike? Can he handle traffic on either mode? Is he active on the air, at least an average of one hour a day? Does he take a modest interest in contests, enough to keep his hand and his ear in? Is he strictly a "roundtable" type operator or does he get in and dig out the station he wants thru the QRM?

5. Is Mr. C. thoroughly familiar with the background, aims and basic purposes of ARRL? Is he well informed of the manner in which ARRL has, and has not, faced up to current problems? the past situations? Is Mr. C. satisfied and content with the manner in which ARRL is being managed, controlled and with its current overall policy?

6. Is Mr. C. willing to openly state his opinions on controversial questions? Does he actually HAVE opinions? Will he back them up, in writing? Will he stand up and fight for his convictions when the time comes to be counted?

7. Is Mr. C. a person that can be swayed by pressure or by power-political groups who are acting against the best interest of Amateur Radio and the ARRL? Is he thoroughly honest? Can his vote or opinion be purchased? Will Mr. C. face issues squarely and sincerely with a desire to settle them in the highest basic ARRL concepts? Will he stand up for his ideals or will he fold up and keep silent when the chips are down?

8. Will Mr. C. ascertain the views of his constituents, prior to his voting on important issues? Will he stand by majority opinions and uphold your views, or will he, like so many, refuse to take polls, and refute their results even if he does take them?

9. Will Mr. C. demand that ARRL conduct member polls on important issues. Will Mr. C. refuse to be by-passed by ARRL HQ or the Executive Committee and will he actually be a DIRECTOR?

10. Will Mr. C. sit idly by while worthwhile legislation dies on the "table" or for lack of a second, or thru the political chicanery of pre-Board meeting sessions? Will he condone these "secret sessions" held to formulate and solidify these Board "14-1 or 15-1" votes?

11. Is Mr. C. a blind follower of the ARRL Party Line? Does he believe that their "policies" must be upheld, right or wrong, without question and without opposition from anyone?

12. Will Mr. C. faithfully report all important overtones, and deliberations of a Board, Executive or Working Committee so that members will KNOW the WHY behind decisions? Will he make such reports to you, in writing, minus the propaganda handed out by ARRL political power leaders.

13. Is Mr. C. a typical Amateur, and does he inspire others? Does he have a reputation for straight dealing, from the top of the deck, in all his works?

14. Is Mr. C. willing to seek and to take advantage of every opportunity to learn more about the widespread importance of a Director? Will he then, having been so informed, ACT?

15. Is Mr. C. a "blow-hard" on or off the air about Amateur Radio or does he really know his stuff as an Amateur? Technically—so that he can equate the technical problems that SHOULD come up in connection with Board deliberations? Politically—so that he can cope with the machinations of other less-honest Board members?

Naivete is NOT a desirable characteristic of a DIRECTOR! Mr. C. must not be a "Casper Milquetoaste" but must be able to stand on his own two feet and battle it out with the "power-pros" who will give him a very hard time when opposed.

16. Is Mr. C. willing to accept a job that will take tedious hours of correspondence, long conferences with other Board members (it is hoped), discussions with members on and off the air and the preparation of reports and studies of the Amateur scene? Mr. C. need not be wealthy. There are ample ARRL funds for his expenditures (if he will only request them) but his position or job must permit frequent absence from his desk or bench. He must be willing to spend countless hours in deliberation over Amateur affairs. He will of necessity curtail his operating time, but he need not feel obligated to check into every net and to increase his operating time beyond that point where he can feel in touch with modern conditions. He MUST be cognizant of current events.

17. Is Mr. C. willing to solicit and listen to your views and opinions, and then will he ACT to preserve and enhance Amateur Radio, in the old time basic ARRL tradition by faithfully and fully DIRECTING the operation of ARRL?

If your Mr. Candidate will answer the above questions to your own personal satisfaction, you can then *measure his Q* and decide if you wish HIM to represent you!

If he does—pitch in and ELECT this man. If he does not—tell your fellow Divisional members!

New Product

Tuning Condenser

VHF'ers in particular will be interested in the variable capacitors that British Radio Electronics are importing. These are pretty perfect. There are so many fine details that it is difficult to know where to start. Features: silver plated brass rotor and stator assemblies; full ball bearings front and back; shaft extends both front and back; rotor contacts are nickle-silver, silver plated; two sets of double rotor contacts for each capacitor section; continuous rotation; straight line capacity with two adjustable plates on each section; straight line frequency rotor plates available also if requested; mounting brackets built in separate from stator assembly; each stator segment held in place by four ceramic insulators. These units are available in one, two or three sections, in sizes from 10 to 104 mmfd. Builders who want a tuning capacitor for a VFO or receiver would do well to send for a data sheet from BREI, 1742 Wisconsin Avenue, N.W., Washington 7, D. C.

Moonbouncing News

W2NSD/1

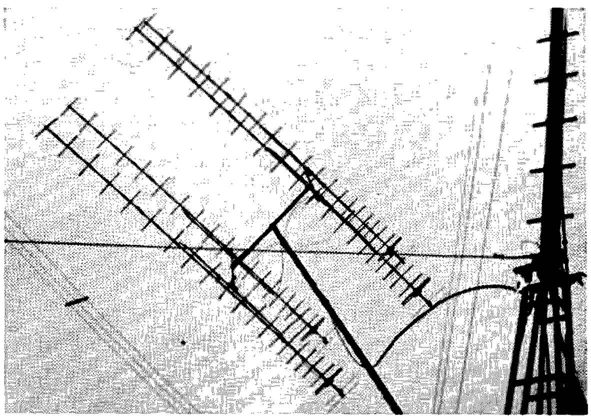
KP4BPZ was in there during the ARRL VHF QSO Party on June 13-14 on both two meters and 432 mc. The time and frequency of the skeds were announced by several hundred IoAR member stations and by ARRL's OBS. Many groups were sparked into giving moonbounce a try. All of my antennas were pointed at the horizon, so there wasn't much I could do about it except plan for the future.

Word reached me during the contest that KP4BPZ had indeed managed to contact several 432 mc stations on Saturday and several 144 mc stations on Sunday. I called Sam W1FZJ for details and got the following list:

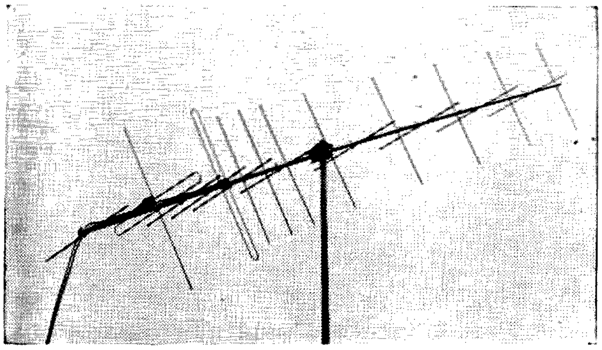
The operating position at KP4BPZ looks more like a BC station than a ham setup. Andy KP4BEU is in the foreground, Gordon BPZ is at the key, Rolf K6DSJ is on the left, and Pete K3SSG is hidden Gordon.

432 mc . . . W1BU, W9PAB, HG9RG, W1EHF/1, W9NGE, W1FZJ on AM phone, G3LTF, and W1HIV. The W1BU, W1EHF, W1FZJ and W1HIV contacts were all with the same rig. One of the W9's isn't in the Callbook, so it is possible that both W9's used the same rig. This still gives Gordon four different stations worked . . . not bad. BPZ was heard several places too. K2TKN lowered his dish to the ground and copied BPZ, but with difficulty since Gordon was sending CW at about 35 wpm, which made it difficult to tune in.

On 144 mc Sam reported that KP4BPZ worked W1BU, K2LMG, G2HCG, WB6GZY, DJ3EN, W3TIK/3, W3TMZ, W3LUL/3, W9GAB/3 (maybe that's why there is no W9PAB in the Callbook?), W1HIV, DJ8PL, W4HGZ, DL3YBA, W4FJP, and WICØ. I sent letters immediately to all of them asking for details. Several have answered . . . and I was surprised to find that my letter was the first that a couple of them knew that they had actually made a complete QSO.



DL3YBA heard KP4BPZ S-5 with this 88 element (four 22's) 432 beam. Contact was made on 144 mc with a double ten element beam.

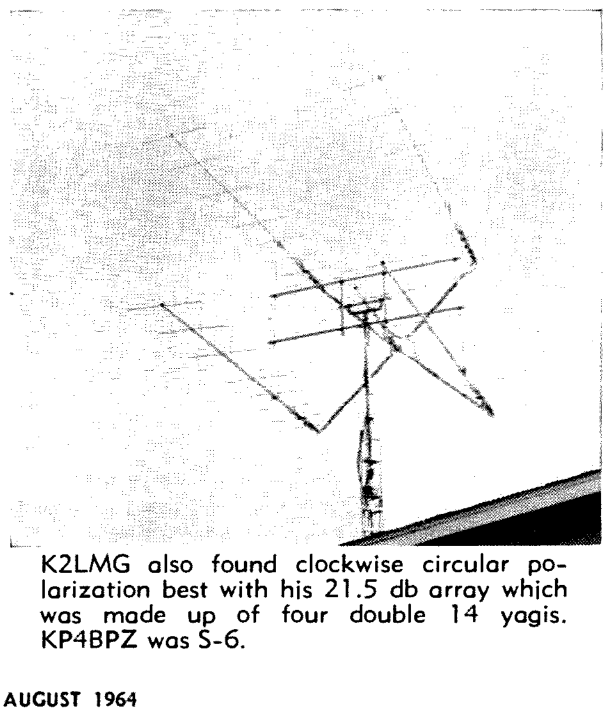


G2HCG's double ten yagis. Best results were with clockwise circular polarization. KP4BPZ was S-4.

The first report came in from G2HCG. Bill was using a set of two 10 element J-Beam yagis mounted on the same crossboom at quarter wave spacing. This provided circular polarization without the usual matching problems. When both beams are fed in phase the result is clockwise circular polarization. When a half wave is inserted in the feeder to one antenna the polarization becomes anti-clockwise. KP4BPZ was received on 144 mc using a 417A grounded grid converter into an AR-88. The signal was subject to violent variations in strength, peaking at S-4, but most of the time in the noise.

Bill reports considerable frequency shift at the beginning of each transmission, probably due to transmitter drift. The G2HCG transmitter ran 1 KW to a pair of 8011's. Signals were poor on vertical, horizontal and counter-clockwise circular, but were manageable on clockwise polarization.

K2LMG in South Lansing, New York copied KP4BPZ the entire time he was on two meters. He used his 21.5 db gain antenna, made



K2LMG also found clockwise circular polarization best with his 21.5 db array which was made up of four double 14 yagis. KP4BPZ was S-6.

up of four 14 element yagis with both horizontal and vertical elements phased to provide any type of polarization. The converter was a 7077 grounded grid followed by a 417A and a 75A3. The transmitter was a 6N2 Thunderbolt. Reports exchanged were 569 and 579! Using a bandwidth of 150 cps the BPZ signal varied from the noise up to 20 db over the noise. Most interesting of all was the five second delay between transmissions waiting for the radio signals to cover the path.

DL3YBA near Hannover, Germany, reported BPZ at S-2 on 144 mc with his double ten element beam. Contact was made running 1600 watts input, with probably 600 watts being radiated by the antenna. Fritz's four 22 element yagis on 432 brought in BPZ an S4, but no transmitter was ready as yet.

I'll try to let you know more about the others who have succeeded with moonbounce. In the meanwhile, have you thought over what is needed to enter this activity? The primary requirement is interest. Low noise figure converters are not hard to build (or expensive). High power is not very difficult either. But the antenna . . . ahhh, there is the key to moonbounce. None of the antennas used so far have been beyond the achievement of the average amateur, except those used by BPZ and Sam, W1FZJ. Does anyone know where I can get a large dish?

. . . Wayne

Correspondence from the Members

Letters we bet you won't see in QST

The American Radio Relay League
Dear Sirs;

I received my first license W2UIW in 1941 and passed my Class A ticket shortly after. This license expired by my error and I now hold the call K3FXR.

I let my subscription to QST expire many years ago when I left you were not providing the necessary leadership in the post war years concerning incentive licensing. In particular your position on Appliance opperators.

Let me now renew my membership and say "let's go with this incentive business." I am a communications engineer with a degree in engineering and hope that your proposal will be so strict that I can't quite qualify for complete privileges.

Charles Fenner K3FXR
Shippack, Pa.

Aha, here's a fellow in favor of RM-499. He's going to throw all you others off his bands. In 1941 they were issuing the W2O's, as I recall . . . Wayne.

Dear John:

I am enclosing herewith the QST Expiration Notice along with my check in the amount of five ($5.00) dollars for another year—even though I received a letter from your assistant in reply to my letter to you, thanking me for my letter telling why I was not renewing my membership—something that was not in my letter, and proves that you and your staff do make mistakes. All I was asking for was your resignation for not doing the job for which you are paid.

I have just returned from attending the 32nd National Convention of the Mexican League of Radio Experimenters and it was certainly disgusting to note that ARRL was not represented, even though the Mexicans had a big sign up welcoming ARRL. It was further disgusting to note that our southwestern director could not even keep a schedule with one of our California Hams for the purpose of taping a speech from him to the convention. Another ham answering the scheduled call, telephoned his home to find out that he was out at a park, but was due back soon—15 minutes after the schedule.

It is a shame that you could not have attended this convention as I am sure that you would have found out from our Mexican friends just how to treat your fellow man. In not one instance did I notice anything but decent friendly treatment to all. Quite different from the high and mighty treatment we, who pay your salary, receive from you. But then, that is to be expected from ARRL from what I have observed in the two years I have been a member. I will continue to be a member, so that I can have the privilege of helping to vote out of office the present director for our area. This will be our answer and effective.

I am sending a copy of this letter to Wayne Green so that at least someone will know that all—or not even the majority of the amateurs are in agreement with you and your friends.

R. R. (Dick) Bauer K7UOY
Warren, Arizona

Dear Mr. Huntoon:

As I ran my finger through the June issue table of contents, I saw the call W6SAI pg. 28. I didn't even look to see what the title of the article was. My past experience with this call meant good reading. When I saw the title of the article, I thought it a bit different from the W6SAI Oscar, S-9 Signals, Quad Antennas and other technical articles, but figured it would be good. I read the article titled: "A Look Inside Petition RM-499," twice because I couldn't believe my first impression. First of all it was not a look inside Petition RM-499 as the title states. It was just another review of the letters for and against the petition with a slightly different twist. Mr. Orr attacked all or some hand picked letters and fellow hams who wrote them against RM-499. Mr. Huntoon, I would like to come to the defense of the hams he attacked.

#1. In his first comment Mr. Orr says that hams in favor of a poll or vote are ignorant to basic democratic process. I don't think so Mr. Orr. I live in a town where a vote was taken every time our local government wanted to make any changes that effected the majority of the residents. I have seen a handful of votes put school busses in my town, a library, extra classrooms and even a private beach. This is basic democratic process in our form of government. Congress is a little more complex and I would hardly compare the ARRL organization to that body of democratic representation. I would say your comment was unfair Bill.

#2. I agree with your second comment Bill and I think we all realize the primary reason for amateur radio, but lets not misinterpret the word hobby. The dictionary defines the word hobby as: "a favorite pursuit." If radio is something you like to work with, then naturally you're going to try and work with it the best way you know how. I am not a technical expert on radio theory but I have a thorough working knowledge of my equip-

ment, I like to build electronic components and I don't restrict myself to radio alone. A sense of pride and accomplishment go along with things you do and build when its something you like. When a ham is a service to the public, its food for this proud feeling he has. You demonstrate to the public a special hidden talent. Who in his right mind would pass up an opportunity such as this. I consider amateur radio as a service for the public and for me, a favorite pursuit.

#3. I think hams have every right to think first of their personal investment. Amateurs have to build or purchase the equipment before they can be of service to the public. The people who manufacture the parts and equipment are not giving them away. Hams have to shell out good old hard earned money. If the petition causes a flooding of the used equipment market, values will drop and the hams are the only loosers not the manufacturer or the public.

#4, 5, 6. I agree 100% Bill.

#7. Now here we go again. "RM-499 is unfair as it takes away my rights." Hams who said this, are correct and you proved this with your own comment Bill. Part 97 is F.C.C. repeat F.C.C. regulations and not A.R.R.L. regulations. RM-499 is an A.R.R.L. petition *to* the F.C.C. The Leagues petition is an infringement of the rights of its own members. This gives the hams the legal right to complain.

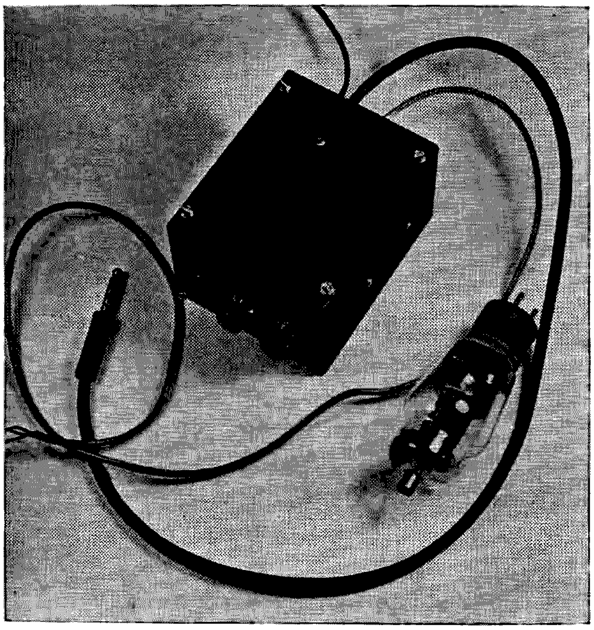
#8. Why should a person have to demonstrate phone qualifications? What is so special or difficult about operating phone? Other than building a modulator and being microphone shy, I see nothing extra special. Both are easy hurdles to clear. The contact is a little more personal and usually shorter and that's about the size of it. How does the public benefit? CB operators use phone and they don't have to take any exam at all.

#9, 10. I am not that familiar with either one of these problems but if the form of testing has been abused, then something should be done to rectify that situation. You could say that comment #10 will take quite a few old timers off 75 phone.

The section titled: "Interesting Side Observations" was very uninteresting and uncalled for. You're really scraping the barrel when you pick on someone because he's a poor speller. They may be weak in spelling but it shows a weakness in character on the part of the author when he resorts to tactics such as these. The opening sentence in the last paragraph sums up very nicely how lopsided the article was. I think the entire article should have been written in italics. The letters for and against the petition deserve more than a casual observers opinion. I don't see why the poor stamp collectors and hot-rod racers were pulled in at the end. They must have complained about TVI at one time or other. Come on Bill, give us some of your other articles that we can digest and feel we have learned something.

To conclude, the only thing you accomplish with RM-499 is to be in the F.C.C. spotlight. You might say it's like a little boy doing something clever in school and hoping the teacher will take notice. Well you're missing the target entirely. We don't have to prove ourselves to the F.C.C. We have to prove to the public, our country and our neighboring countries the importance of our existence. Why not show the F.C.C. a program for cleaning up sloppy operating habits, inconsiderate operating on the air and all other QRM on the ham bands? Our intelligence does not have to be tested, merely some age old regulations have to be intorced. This is what the F.C.C. is looking for.

John A. Snee W2BID
Jamaica, New York



The completed unit shown with an 807 for size comparison.

Another Keyer

Adam Keller K9SGZ

Being a CW hound by nature and choice, I am constantly building gadgets which are intended to make this mode of operating even more enjoyable than it is. The keyer described herein claims no radically new concepts, but is a simple, rather inexpensive device which will send perfect code as long as the nut behind the wheel is working the paddle in a proper manner. It is completely self contained, other than the paddle, and includes its own power supply and keying relay. It is built in a 3 × 4 × 5 chassis box with the transistors mounted on homemade circuit boards. It may be used with either a "squeeze" paddle or with a conventional paddle, and is *not* self completing. This feature was purposely left out of the keyer, even though it may be added with just three or four parts, since when the dots and dashes are self completing, there is no more individuality left in the device. Also, it allows the operator to forget how to send proper CW and makes it very difficult to transfer easily from a "bug" to a keyer and vice versa. You can very easily prove this statement to yourself, just ask one of your friends who has used a self completing keyer for some time to try to send CW with your old favorite "bug". If he can, he is a rare animal indeed. This is a point many people disagree on, but it is a fact like it or not.

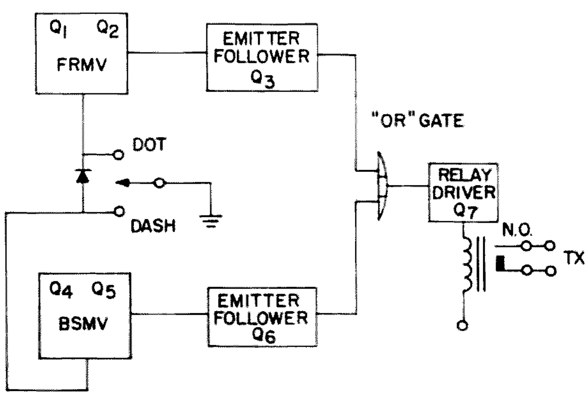
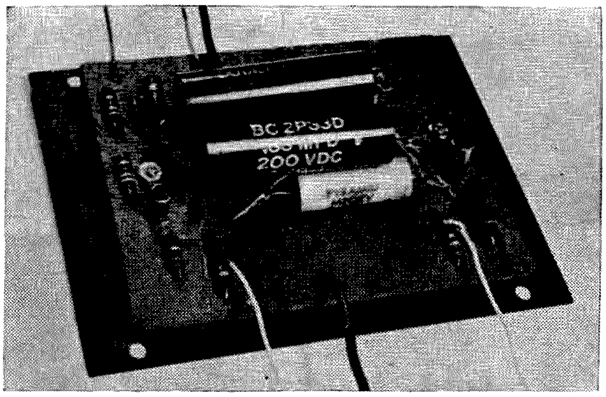


FIG. 1

The keyer is rather conventional in that it consists of a free-running multivibrator which generates dots, driving a bistable multi-vibrator which adds to the dots to produce dashes. The block diagram is shown as Fig. 1. The circuit is rather novel, in that it uses only one power supply, whereas most transistor units described elsewhere use both positive and negative supply voltages. This saves a bit on cost as well as simplifying the power supply. Two circuit boards are used, one containing the FRMV and half of the "OR" gate, the other containing the BSMV, the other half of the "OR" gate, and the relay driver transistor. Photo 1 shows the layout of the board containing the FRMV and it's associated emitter follower, while photo 2 shows the BSMV board. The cutout in the BSMV board is for clearance of the keying relay. With more precise measurements taken before construction, it is possible to get by without doing any hacking here. The stack of capacitors on the FRMV board make up a pair of 1 mfd capacitors, again because of availability. Considerable space may be saved here with a single capacitor. These boards are held away from the chassis box side panels by some spacers made up of two #8 nuts. Care

should be used here to ensure that none of the wiring on the boards touches the side panels. A short circuit here can cost you a transistor or two. Photo 3 shows the interior of the chassis box along with the two completed side panels. The speed control is on the left, the weight control in the center, and the power switch on the right. The power transformer is mounted on the right wall of the box, while all diodes and filter capacitors are on the left wall. The capacitor which may be seen on the left wall is the 1000 mfd unit, the diodes and 100 mfd capacitor being hidden by the large capacitor. The keying relay is mounted on the bottom wall along with a terminal strip used as a tie point for the power cord.

When constructing the unit, it is advisable to construct the power supply in the chassis box first, so that it may be used for checkout of the boards. Once the power supply is complete, the FRMV board may be constructed and checked out. With the FRMV board connected to the power supply, leave the emitter



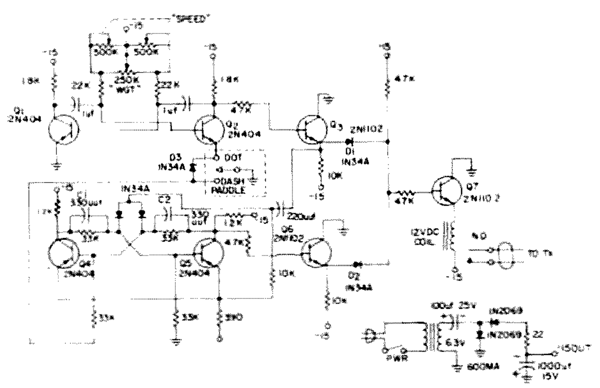
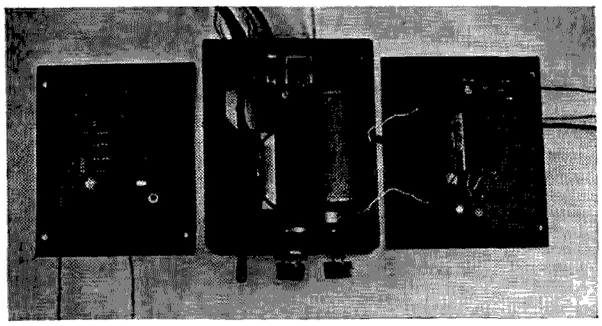
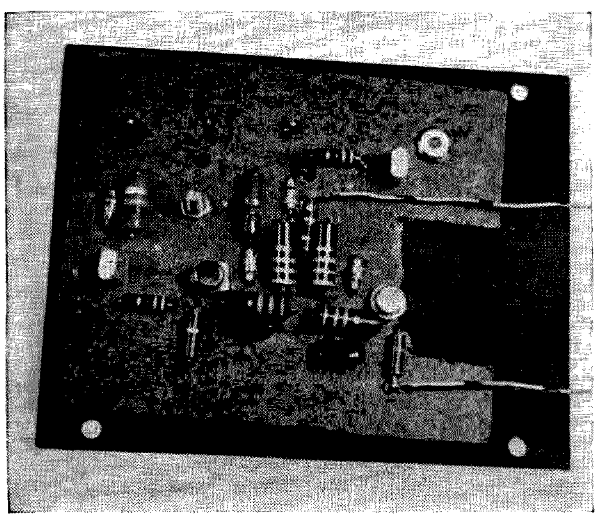


FIG 2

of the keyed transistor (Q_2) disconnected. With a voltmeter, measure the voltage from the collector of the keyed transistor to ground. This should be about 14 volts or so (negative, of course). Then measure the collector-to-ground voltage of the other FRMV transistor. This should be about -0.2 volts or so. Notice that the speed and weight controls must be connected temporarily for these checks. Now, with the voltmeter still connected from one of the collectors to ground, connect the emitter of the keyed transistor to ground. You should note the voltmeter reading change toward about -7 volts. This will be affected by the weight control. You should find some setting of the weight control where the collector voltage is about -7 volts. This is probably most easily accomplished by setting the speed control wide open (minimum resistance). If this checks out OK, proceed to the BSMV board.

With the BSMV board connected to the power supply, leave the key lead open. With a voltmeter, measure the voltage from the collector of Q_5 (see schematic) to ground. This should be about -12 volts or so. Then measure the voltage from the collector of Q_4 to the emitter of Q_4. This should be about -0.2 volts or so. If these voltages check OK, all interconnections may be made between the two boards and their operation may be checked. With the "dot" lead grounded, the FRMV should operate and it's collector voltages should be about -7 volts as described above. With the "dash" lead connected to ground, The FRMV should still operate as before, but now the BSMV should also be running. This may be checked by measuring the voltage from either collector (Q_4 or Q_5) to ground. This voltage should be about -7 volts also. It should be noted that all the above voltage readings are dc readings, which are actually the average voltages of the waveforms seen on the collector. If an oscilloscope is available, the waveforms shown as Fig. 3 should be observed when the "dash" lead is grounded.





If all the above checks are OK, the keying relay may be connected to the transistor Q_7 and proper transmitter keying should be noted. If a 24 volt relay is used, as in the author's model, the spring will have to be weakened by stretching before the relay will operate on the low voltage used in the power supply. If a 12 volt dc relay with a coil resistance of 500 ohms or greater is available,

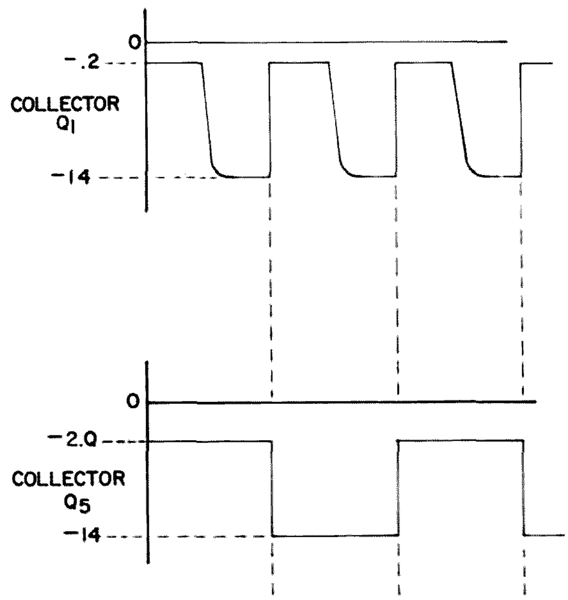


FIG 3

it may be substituted directly. Once the relay is operating, the weight control may be adjusted by "ear", or more precisely by using an indicator such as the grid current meter on your transmitter. If the transmitter grid current runs, say 5 ma with the key closed, a string of dots should produce an average reading of about 2.5 ma on the grid meter. The dashes are automatically correct if the dots are correct and the BSMV is running.

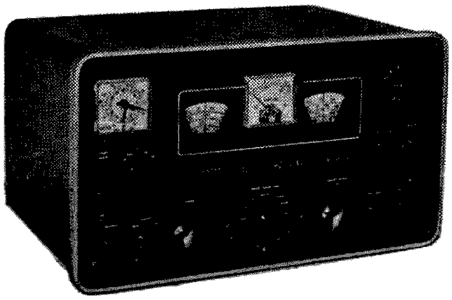
From here on, the package may be "buttoned up" and you are in business with correctly formed dots and dashes, with the operator still controlling the keyer, not vice versa.

A hint here may save you a little money, almost any switching or audio transistor will work for Q_1, Q_2, Q_3, Q_6, and Q_7. They should have about a 20 volt or greater collector voltage rating and Q_7 should be good for 50 ma or so of collector current. After this, you're on your own. Oh, yes, if you experience any difficulty getting the BSMV to run, providing the circuit is wired correctly, try increasing the values of C_1 and C_2 slightly. They should require very little, if any, change if you use 2N404 or 2N604 transistors or equivalents.

Have fun and will CU on 80 meters around 3650 kc. That's home to me.

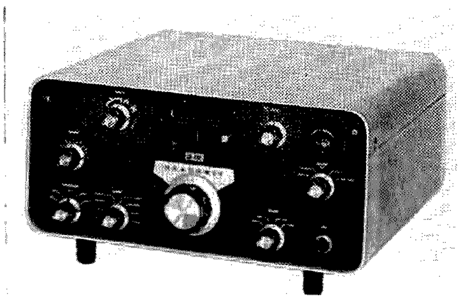
. . . K9SGZ

New Products



Eight Band Receiver!

Hammarlund has introduced the first ham receiver to cover 2-160 meters in one package, their new HA-170A-VHF. This is the regular HQ-170A plus built-in nuvistor converters for 6 and 2 meters. Activity on two meters is growing rapidly, so you might look closely at this receiver. The converters in the HQ-170A-VHF are right up there with the best available, complete with nine tuned circuits to give good rejection of unwanted signals.

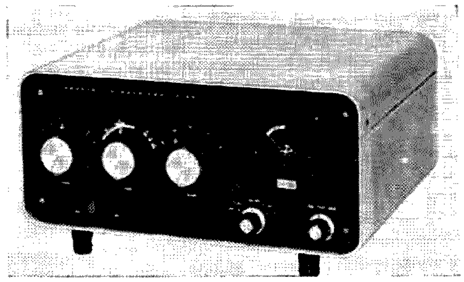


Killowatt Linear

The Heathkit SB-200 KW Linear Ampli fier is a completely self-contained desk-top unit which provides 1200 watts PEP SSB, 1000 watts CW in a grounded grid circuit. It covers 80 through 10 meters and is designed to mate with the SB-400 Heathkit transmitter, the soon-to-be-released SB-100 transceiver and nearly all other SSB and CW exciters in use. Antenna switch and SWR meter are built in. Price? $200!

New Catalog

International Crystal has a new catalog just out. This is an interesting 24 pager showing all of the Add-On Circuits they have available. They have really expanded this concept tremendously, covering audio amplifiers, converters, sideband filters (xtal, natch), multivibrators, oscillators, transmitters, power supplies, voltmeter, etc. Write to International Crystal, 18 North Lee, Oklahoma City, Oklahoma 73102. Mention 73?



SSB Transmitter

The Heathkit SB-400 transmitter is designed to match the Heathkit SB-300 receiver and runs 180 watts PEP SSB, 170 watts CW on all bands 80 through 10 meters. The linear master oscillator is calibrated one kc per division, 100 kc per dial revolution, with bandspread equal to ten feet per megacycle. It gives 500 kc coverage in each band switch position. Upper or lower sideband, VOX, PTT, CW break-in, built in antenna switch, ALC, etc. Price is $325.

Letters

Dear Wayne,

I just returned from a visit to the World's Fair and I can tell you first hand that you are correct in your statements on K2US. I finally found the door leading to the "Glass Cage" housing the wonderful display of Hallicrafters equipment. There were three operators. I assume they were amateur radio operators as they all wore brown jackets with K2US on the back. All I saw was their backs, wandering around like chickens with their heads cut off. There was a speaker mounted on the wall between us with directions on how to get those inside to know we were outside. After several attempts to get a "CQ" through to them, following the printed instructions posted beside the wall, I gave up and walked away. I then went to WA2USA and found the equipment, but no operators. I inquired as to the reason and was told that it was not ready to go on the air as construction was not completed. I am glad to find out the real reason in the July issue of 73. Too bad the ARRL has the power to do most anything they desire.

Charles O. Fleming WA8GLR
Sylvania, Ohio

Dear Mr. Green;

A group of amateurs in the San Francisco, California, Bay Area are interested in getting a national calling and operating frequency for wide-band FM operations in the 420-450 mc amateur band. This frequency would be the UHF equivalent of 52.525 mc in the 6 meter band and 146.94 mc in the 2 meter band. Several members of the club have operating base and mobile stations on a frequency of 449.500 mc. There are seven stations on the air now, five more with the necessary equipment, and many more members have expressed interest. Inquiries among various FM groups around the country have shown that there is no common frequency as yet in this part of the band, so perhaps this would be an appropriate time to establish such a frequency.

The members of our group have selected 449.500 mc for several valid reasons. These are listed below, not necessarily in order of their relative importance.

1) All surplus 450-480 mc FM two-way radio equipment we have tested will tune onto this frequency without conversion or loss of receiver sensitivity or transmitter power output.

2) This frequency is quite isolated from the national AM frequency of 432.000 mc. Since, for all practical purposes, AM and FM systems are incompatible, this isolation will prevent conflicts between operators using different types of emission.

3) A common 100 kc or 500 kc frequency standard may be used to set frequency by zeroing the receiver discriminators and netting the transmitters to the receivers. Also, in commercial systems, channel spacing in the 450-480 mc band is 100 kc. The 449.500 mc channel is an integral number of 100 kc steps inside the band.

We are writing to you in the hopes that you will consider our proposal and perhaps publish comments on the subject and solicit comments from other groups with interests along the same lines as ours.

Alan Christian WA6YOB
Grizzly Peak VHF ARC

Sounds like a good idea to me . . . Wayne.

Dear Wayne,

Well, I'm finally doing it. I'm finally coughing up the $10 to become a Founding Member of the Institute of Amateur Radio. I held off as long as I could, but now my conscience is bothering me. After all, who am I to freeload on all those benefits that the Institute will afford to amateur radio; the bands that it may cause to be saved for us at Geneva; the benefit of getting legislation passed when we need it; but most of all I get the satisfaction of knowing that I belong to an organization that represents all amateurs, and not just a hand picked few.

I believe, Wayne, that the $10 membership dues is just a drop in the bucket compared to what most of us have spent on our rigs. Where else could we get "insurance" so cheap, insurance that our equipment won't be obsolete in a couple of years as a result of the big doings in Geneva.

Well Wayne, this is why I am joining the Institute of Amateur Radio. Frankly I can't see why every ham who cares about the future of amateur radio doesn't join.

Ed Hartley WA2VGH
Brooklyn, New York

Wayne:

You goofed. In my article, "The Gardner Modulator Revisited" in the May issue you show a lead going to B + in Fig. 2. This is an error. There is no B + necessary with this circuit. This is one of its big advantages. B + is derived from the drop across the 6Y6 when plate current flows through the common amplifier modulator circuit. Thus only 6.3 vac is required.

73
Barry Hoyt
WA2AKK

Gentlemen:

I am writing the following because I am interested in Amateur Radio, the services it offers, both personal and public and above all, its continuance.

I read most of the articles every month in your magazine with great interest and being a natural "ham," I feel I have to put my two cents worth in also.

The general conclusion I get from most of those letters and articles concerning the fate of Amateur Radio at the coming Geneva convention is one of doom and gloom. I have to agree with most everything that it said; we amateurs have our problems as everyone else does. The problem as I see it is: what do we about it and are we willing to sacrifice of ourselves to see that something is done about it. In other words I am going to offer what I consider to be an offensive step. I am not satisfied to just "hold our own" frequency allocations, but instead I would like to see more of the spectrum allocated to Amateur Radio. Well and good you say, but how is that ever going to come about. Well maybe it won't but it won't be because I haven't given it the old college try, so to speak.

From what I can gather from this edge of the map, the only thing these people that control our frequencies really and I mean really pay attention to is "hard nose politics." Who in this wide world is in a better position for collective bargaining than Amateurs with Mr. Barry Goldwater in their ranks. I don't like the word politician and I don't mean to associate it with Mr. Goldwater but it seems that politics is all some people understand. So, whats wrong with pulling together by printing a ballot or poll in your magazine and other amateur magazines with definite propositions put before the ranks and if amateurs can't mark them and return them to a collective point then they deserve to lose their privileges. Then after we feel we have a majority of the feelings of the amateurs, present this in a petition form to our state Congressmen or Mr. Goldwater or whoever should present our views to the powers that be and see if we don't get some action. I believe they will listen to a majority, if we get a majority together.

How do you think commercial ratio has taken frequencies away from Amateur radio in the first place but by politics and by a powerful lobby in Congress. Well, why can't we Amateurs have the same thing if that is all they understand.

I say let's be practical, let's get together and make some sensible demands of our own through the proper channels and be prepared to back up our demands. I for one am willing to work to stay on the air on our present frequencies, are you . . .

Jon Raine K5IUS
Uvalde, Texas

You've got the idea Jon . . . fight demands with demands and fight lobbies with lobbies. That's why we have the Institute of Amateur Radio. . . . wayne

Dear Wayne,

Looking down at my car's odometer yesterday, I saw it roll over to 737373. Since I have not exactly ignored your publication, this sequence created a chain of mental aberrations which resulted in my sending the enclosed check for a three year subscription to your rag. I enjoy perusing your articles and have learned much of practical value from the technical articles by Jim Kyle and others. In fact, I like it so well that, although I have not previously subscribed, I have nearly all back issues since you introduced "73."

Concerning the current agitation over conditions in the hierarchy of the ARRL, and other individuals whose personalities and/or opinions you do not agree with or care for, I feel you could accomplish your purpose of exposing and pointing our their errors without the use of such bitter and sarcastic language. I feel that hams, on an average, are blessed with a high enough intelligence to evaluate and make their own decisions on controversial subjects when all the facts have been presented to them objectively and dispassionately. Personally, I view with

distaste and suspicion any attempts to influence my thinking by methods other than a simple exposition of the facts. I question the motives of a man that attempts to prejudice me rather than convince me. My criticism is intended to be solely constructive, since I heartily support your efforts to reveal the true conditions in the League. I believe you are doing all hams a service and only wish to point out that you may antagonize some by your method of attack.

Keith Carlin WA6AOM/Ø
Minot, North Dakota

You've made a good point Keith. Undoubtedly the straight facts would get the message across to many fellows . . . but then you must take into consideration that I get great enjoyment out of being sarcastic and I suspect that many readers enjoy having me zing people a bit. You'll note that I do not waste time zinging people who can take it, only those with no sense of humor who gnash their teeth in frustration. And please don't read bitterness into my histrionics. I'm having a good time . . . I sit back and read my editorials and laugh . . . try it.

Some Important Design Hints with Transistors

William Eslick KØVQY
2607 East 13th
Wichita, Kansas

Transistors are invading the vhf field, believe it or not! I know some die hard hams who won't accept the fact as yet and others who have 'tried' and gave up cursing the little hunks of metal.

In this article, I hope to tell you of a few pitfalls to avoid and some helpul hints you won't find outside of 73. If you have lots of that green stuff to buy transistors, don't read this—but if you save your lunch money to get that little precious jewel, then this is for you.

One thing to be sure and do is to have a meter (milliamp) in the supply line. This will warn you when you are exceeding the rated input current and will let you know when something goes wrong. So have a few current meters handy! Another must is a resistor in the emitter circuit, bypassed of course. When the transistor tends to reach thermal runaway, (as it gets hot it will draw more current, get hotter and draw still more current till it is ruined). Without theory this resistor provides a voltage drop that bucks the forward bias—more current the transistor draws, the more 'bucking' is done. Less forward bias means less current drawn. This resistor will range from 10 to 15 ohms for audio or rf final and from 100 to 1k ohms for audio or rf.

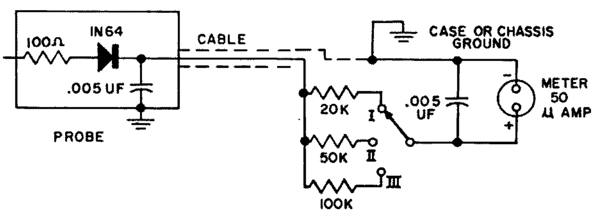


FIG. I

By these two methods, we have come a long way in saving our investment. One more very important thing, for gosh sakes, remember polarity. Seems like this fault is high on the list for the cause of ruining transistors.

Remember this little thing . . . If your transistor is a pnp (or npn) the middle letter tells you the polarity of the collector voltage and also forward base bias if any is used. So if you have a pnp, then the collector supply will be negative with positive going to the emitter circuit and forward bias, if any, will be negative.

In case you have not found this out, in the common circuits, unless the transistor input and output's are tapped down on the tank coil you will not be able to use a gdo very easily. Reason is that the transistor shunts the tank coil with a low impedance and the dip is hard to find (if there at all). Another difficulty that has thrown more than a few is: they design a tuned circuit, plug the transisor in and it won't work! The transistor input (output) capacitance will alter the tuning very much. Even with a tuned slug coil, turns will have to be removed. (One oscillator circuit I used had a 20 mmfd capacitor across the tank with core about half in the coil. Gdo okay, but with transistor in,

I wound up with 5 mmfd across the coil before it would tune to frequency. Now you are warned!) In Fig. 1 is a diagram of a simple rf voltmeter. It is uncalibrated (although the resistors and meter give ranges of 1, 2½ and 5 volts) because loading/shunting affect would make any reading useless except as for the presence of rf and that is its sole purpose.

This meter must be connected across a load or it will not read. Do not use it across a dc voltage source that exceeds the range of the meter.

In a circuit like Fig. 2 with voltage supplied to the oscillator section only, both transistors plugged in, meter connected between base and chassis (or emitter) of the final, then I can work with the oscillator circuit till it oscillates. A reading of 30 on range one to 35 on range two is roughly what I have read with various oscillator circuits and frequencies. When the oscillator circuit is working properly, connect a dummy load (bulb or resistor) to the antenna output terminals and connect the meter across this and work with the final (or next stage) until it is working. This little indicator is almost a must if you intend to experiment with transistor circuitry. Now for a few hints: I hope you may find the cause of your failure and disgust mentioned here and start saving lunch money again for transistors.

First try to get some design reports. Amperex and Texas Instruments are very nice in sending booklets with circuits that will give you a good idea how to start. Some of the transistors have a very low input and output impedances and the old 'standby circuits' will not work! Have you had an oscillator working properly and then plug the final transistor in and the oscillator quits? Loosen the coupling or remove a turn or two from the link coupling. The oscillator is loaded too heavily.

In your output circuits, regardless of whether you use parallel or pi network, use a coil that you can tap the collector a turn at a time (and retune the trimmer of course) until you reach the best point as indicated by meter or dummy load. On one of my 50 mc finals using a Amperex 2N2786, the tank is 6 turns of B&W 3007 with a 5-20 mmfd trimmer. The collector is tapped 1½ turns from the cold end for best output.

In another circuit (using a 2N2220) the collector was connected to the center tap of the coil for best output. From this, you can see that it is important but cut and try, procedure to find the proper collector tap on the coil for the best output. The grounded base configuration is the best to use. In most of the vhf transistors I have worked with, using grounded emitter (base driven) circuits, the final stage will take off on its own. I have had the dummy load light up and think to myself, "Good, I've really got some output." Then I would pull the crystal momentarily from it's socket and the dummy load still was lit. To fix this involves too much neutralizing circuitry. It isn't worth the effort. A warning: a transistor oscillating like this can ruin itself quickly. I have found this out to my sorrow and purse!

Another warning. If your final is capable of putting out over 100 milliwatts, always have a dummy load connected or buy another transistor! I wrote one crystal manufacturer about 5th and 7th overtone crystals in transistor oscillator circuits and they did not recommend using over a third overtone if you wanted stability. I have tried several fifth overtone circuits and they left much to be desired (compared to third overtone results).

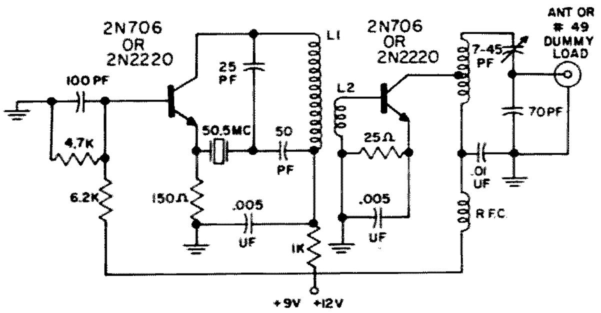


FIG. 2

L_1—¼" dia. 7T #24
L_2—2T at cold end of L_1
L_3—6T Airdux 608 (B&W 3010) CT
RFC—20T #26 on 1W resistor

Actual working 50.5 mc transmitter built and used here to describe use of RF meter and matching.

So in going to 2 meters, I personally recommend using a 24 mc crystal and tripling then doubling or a 36 mc crystal, doubling then doubling to two meters. Meshna and other surplus houses have overtone crystals cheap enough that the savings in crystal alone will buy another transistor.

Beware of these bargain transistors. I have ordered some so called 100 mc types (up to 1 watt) and none would even work on the CB band. They wound up in audio stages. My favorite transistors based on price and results are the Texas Instruments or Motorola 2N706, the Amperex 2N2287 and 2N2786 (which is good for ½ watt at 50 mc and around 300 to 400 mw at 2 meters) and the Texas Instruments or Motorola 2N1143. These are hard to beat if you are interested in vhf. They can be bought at Newark Electronics in Chicago.

Again I urge you to write to the transistor manufacturers for design reports and vhf circuitry if you are interested in vhf.

. . . KØVQY

A Beast for Ten

Mike Schwartz WA2WYJ
42 65 Kissena Blvd.
Flushing 55, N. Y.

When an average ham is on the golf course he may wonder how ten meters is doing. Well, he can't reach into his pocket and pull out a communications receiver covering ten meters—unless he has this "thing" I am about to describe.

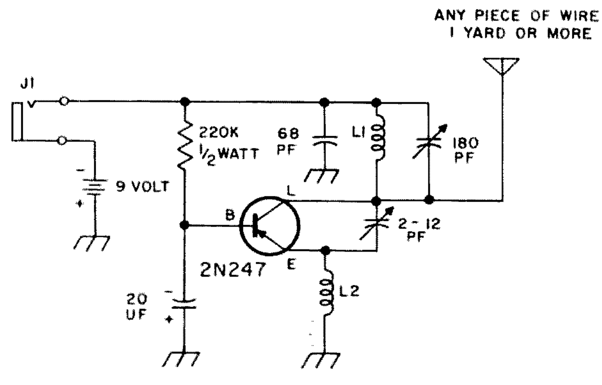
Any ham or swl who can solder should be able to throw this thing together in less than an hour. The circuit is a simple super-regen utilizing a common 2N247 PNP transistor, which you can probably pick up for 2 or 4 bits.

If you were to go out and buy all the parts they would probably cost you about $2.00 (a good investment), but even if you have a sick junkbox the price will probably go down to under a buck.

The only thing to watch when constructing the receiver is to keep all leads as short as possible.

Operation of this "Beast for Ten Meters" is like any other super-regen. Receiver tuning is adjusted by C3 while feedback capacitor C4 is the sensitivity control. Adjust C4 until you hear a smooth hiss and listen to all those ten meter stations boom in. Then jump into the car, go home, only to find that the band died. . .

. . . WA2WYJ



L_1 24T #22 C.T. ¼" form
L_2 75 uh TV peaking coil

(W2NSD from page 4)

it and becloud the issue by saying that their objective was to form a coalition of national amateur societies in this hemisphere. Yes, that is true . . . but they wanted this coalition to be under IARU (ARRL) leadership . . . and they were flatly turned down.

Next the League turns to WA2USA. They mention that WA2USA is now off the air. They do not seem to feel it necessary to bring into their discussion why WA2USA was necessary in the first place or the hundreds (perhaps thousands) of dollars that they spent forcing WA2USA off the air. Will the ARRL ever explain to its members why K2US was taken from a prominent spot on the ground floor and thrown up into the attic of the Coca-Cola pavilion? Can they deny that this happened when copies of the correspondence are in the hands of their own directors? Can they deny that they have spared no expense in trying to either take over or get rid of WA2USA?

If you are really interested in much of the inside story of ARRL's K2US then you must read the June issue of The Monitor. This one article is worth a two years subscription (2 yrs. $2.25, Monitor, Box 4133, Dallas, Texas 75208). Each issue of Monitor is about the equivalent of ten pages of 73, all devoted to discussions of the political aspects of amateur radio.

Now . . . speaking of lies . . . the ARRL letter states that the League's General Council was active in the Denver tower case "more than a year ago." Yet the fellow involved wrote recently, "This is the irony . . . in any discussion with any amateur anyplace regarding the lawsuit, the first question invariably asked of me is this one: 'What is ARRL doing to help you?' I am forced to tell them the facts: Nothing."

ARRL June VHF QSO Party

The name "QSO Party" does not do justice to this contest. This is the biggest and most hard fought VHF contest of the year. Many clubs work for months to be ready for this

(Turn page)

effort. In the past the Waltham Amateur Radio Club (Mass.) has done a sterling job in this contest by driving an unbelievable amount of equipment and antennas to the top of Pack Monadnock, a mountain just a few miles inside the New Hampshire border.

This year the club decided to set up on Grand Monadnock and take advantage of the 73 Villa there . . . and its antennas. The work of installing the equipment started five weeks before the contest, with weekend visits by three or four club members. The last connections were made some two hours after the contest had started with everyone rushing all over the place trying to get on the air and catch up with the rest of the contesters.

The finished installation was impressive. On six meters they had a Clegg Venus with a kilowatt linear, a Redline converter into an Hammarlund HQ-170 and a choice of a 16 element colinear by Cushcraft fixed tuned toward New York or a five over five by Hi-Par rotatable, both on a Rohn 60 foot tower. On two meters a 6N2 drove PP-4-125A's to a kilowatt, a Tapetone converter fed a National NC-303, and the antennas were a choice of a fixed on New York area 192 element colinear-yagi beam by Cushcraft or a 48 element rotatable (Ham-M) Cushcraft colinear-yagi on a 120 foot KTV tower. WIOOP brought in his 220 432 and 1296 mc gear which were hooked to a 32 element Cushcraft 220 mc colinear on a 50 foot Rohn tower with a CDR TR-44 rotator or a 96 element Cushcraft colinear-yagi for 432 mc on the same mast. Hank brought his own 1296 mc dish which he aimed out the window for two contacts, the furthest at about 55 miles.

All bands remained closed for the duration of the contest except for a few minutes when six cracked long enough for a couple Florida sections to be worked. Even so contacts were made down into Delaware and up into Ontario on two meters. Over 300 contacts in 16 sections were made on two; over 350 on six meters. On 220 mc nine sections were contacted and ten on 432 mc.

The Waltham effort included nine operators: K1JCC, W1KSI, W1DDF, W1DDN, W1LKK, WIOOP, W2MSN, W1NUL, W1EGE. Some operated most of the time, some kept things running, some slept, and one kept the victuals in good supply. I seriously doubt if there was a one that did not have a ball.

Field Day Lull

Though I did not submit a log for Field Day this year, I did spend quite a bit of time around the six and two meter bands in an effort to give as many FD stations as possible a contact with New Hampshire. There wasn't much action. I don't think I've heard a quieter Field Day. Apparently this was not only true of New England for I've received letters from other parts of the country commenting on this phenomenon.

In talking with members of clubs that have been quite active during past Field Days, the reason given for skipping this year was member apathy about the League which has translated itself into a "why should I participate in an ARRL event after what they did to me?"

I know it is difficult to put the League into perspective after all these years. Sure, I grew up on THE Handbook, W1AW, and QST too. For quite a few years it almost seemed as if the ARRL *was* ham radio. I know it is like that with tens of thousands of other hams too. The problem with this is that when disillusionment comes, this love of ARRL turns to hate of ARRL. And hate doesn't allow perspective about the good points of the League. This is one of the reasons why I think the "Amateur's Code" is so poor. It deifies the League and sets it up to be hated when the first blunder is detected.

Field Day should be kept alive. It is an invaluable test of our ability to provide emerengcy communications . . . and it is a strong cohesive event in that it requires considerable effort of a group nature. Let's not let our annoyance with the actions of a small group of League officials spoil ham radio for us. For every bad thing that these fellows have done, the League has performed many good deeds. When you read Huntoon's "Dirty Letters" just remember that he is one fellow . . . and that downstairs are fellows spending their working days sorting out DX QSL's for you, sending out films for club meetings, and filling out RCC certificates. When you hear about Hoover moving heaven and earth to put WA2USA off the air remember Bob White up in his office checking over thousands of submitted QSL's, looking for forgeries and cheating, before giving credit for the Honor Roll. Remember Lou McCoy and his fine work for the Novices.

Let's bring Field Day back next year, OK?

Bill Orr, Leader or Demagog?

A demagog is defined as a leader who uses the passions and prejudices of the populace for his own interest.

If you read much I don't have to tell you about Bill W6SAI. He has been writing articles for ham magazines for years . . . interesting articles. He is an owner (half owner, I believe) in Radio Publications, the largest publishers of books for hams, excepting the ARRL. He is the writer of the Editors and Engineers Radio Handbook . . . and he works for Eimac.

Since joining Eimac about five years ago, Bill has taken a very active interest in the ARRL and is given the major credit by many for the seating of Herb Hoover as president of the League. With the submission of RM-499 by the League, Bill rushed into action, sending letters to, I suspect, thousands of amateurs seeking their support of 499. He has written articles on 499 for 73, QST and CQ. When we held our poll on 499 back in March a curiously large number of specially printed postcards came from his area.

His articles on 499 have brought letters to me complaining that he has substituted emotion for facts and has otherwise been devious in his support of this proposed legislation. I too have been critical of Bill for this reason.

Those of you who do believe that RM-499 is a good thing are probably gnashing your teeth. Gnash, but read on. I want you to read Bill's petition in support of RM-499 that he

sent to the FCC. I want you to read it slowly and thoughtfully, paragraph by paragraph.

Some people feel that RM-499 is an open sore that should be left alone. One manufacturer cited this when he cancelled his advertising in 73 (Commaire Products). A more apt comparison might be with a time bomb. However, right now, let's bypass the content and argument of 499, and look at Bill's petition.

Please note that nowhere in Bill's petition has he offered even the slightest support for 499 on its own merits. He is asking the FCC to pass this legislation because if they don't the League will be damaged. Where was Bill when the League was drafting 499 and setting themselves up for such a disaster? Bill, who has been fighting hard for the passage of 499, is saying, in his own way, that the FCC should not deliberate on the content of RM-499, that they should pass it because the ARRL submitted it.

Now, please read . .

Petition in Support of RM-499

1. Radio amateurs today are locked in a struggle with themselves, the outcome of which will determine the future of the Amateur Radio Service. As radio amateurs reflect a cross-section of society, so does Amateur Radio Service reflect in miniature the problems that beset society; the painful civil disobedience in Mississippi, Birmingham, and Dallas, Texas remind us of dark and violent emotions inherent in individuals otherwise judged to be members of a civilized society. Just as birth does not guarantee judgment or compassion, as citizenship does not guarantee reason or intelligence so neither does possession of a radio amateur license guarantee wisdom or forebearance.

2. Within the ranks of amateur radio exist voices of dissention and intolerance, offering simple, easy solutions that entail no responsibility but that appeal to unreasoning minds. These voices are now attempting to tear asunder the fabric of amateur radio by attacking the American Radio Relay League and the 40 years of order and tradition it represents.

3. It is my firm belief that an adverse decision on the ARRL Incentive License proposal (RM-499) will be interpreted as a vote of no confidence in the American Radio Relay League, and will represent a rebuff to all serious radio amateurs seeking to improve the Amateur Radio Service, in the best tradition of public interest. Such a rebuff will cause the ARRL to recoil in confusion, and the ensuing shock will be most damaging if not fatally injurious to this organization, nullifying it as an effective body of amateur opinion and guidance.

4. Into the ensuing void will climb those self-acclaimed, irresponsible dissenters who captivated by their own clamor, have slandered the ARRL in a manner ignominious and slurring to the very character of amateur radio. These sowers of discontent and half-truths who violently oppose the League at every opportunity stand, ever-ready in the wings, alert for the first signs of retreat from reason, impatient to burst forth, frothing pious platitudes for the unthinking, well-meaning but short sighted radio amateurs who, in their unwisdom, place private comfort above public interest. The ascendency of these forces will be a melancholy experience for those who guide and for those who exert police power over the Amateur Radio Service.

5. In closing, permit me to refer to the last, unspoken message of President Kennedy, to be delivered in Dallas, Texas, Friday, November 22, 1963: "There will always be dissident voices heard in the land, expressing opposition without alternatives, finding fault but never favor, perceiving gloom on every side, and seeking influence without responsibility."

6. I commend these sober words to you, and hope that in your deliberations you will note and place aside the voice of those self-seeking radio amateurs who stand ready to dismantle the philosophy of self-advancement and education, of discovery and invention, and of enlightment without which amateur radio is nothing. It is in the public interest (some 200,000,000 strong) that the Amateur Radio Service remain a leader and model of good citizenship and a beacon for those intellectually curious and science minded children of the coming generation. The desire of a portion of the 250,000 radio amateurs to reduce the Amateur Radio Service to agree with their ideas of a comfortable communication hobby is, in my mind, distinctly not in the national interest.

7. I petition the Federal Communications Commission to approve Petition RM-499 with dispatch.

Sincerely yours,
William I. ORR W6SAI

Letter

Dick Martin WA6RMT reminded me that a good answer to (ugh) CQ appeared on the cover of the July 1956 issue of CQ, 3rd cartoon down.

Prints

Rather than carry on long harangues in 73 trying to answer various critics such as Huntoon, Anderson, Cowan, etc., I've taken to writing my answers to criticisms received and printing up a few copies for those that I think will be interested. If you would like to see my answer to some of these smear attacks, I'll be glad to send you a copy of my reply. Please send self addressed stamped envelope with 5c postage on it for each letter.

CUKE . . . my answer to the insulting letters in the July issue of CQ.

WARN . . . a point by point discussion of the June issue of Washington Amateur Radio News, a sort of ARRL-affiliate magazine specially published to fight the Institute of Amateur Radio.

VHFER . . . an answer to an editorial by W8HHS . . . his answer to me, and my further answer to him. Dull.

HUNTOON JUNE 5 DIRTY LETTER . . . a point by point answer of Huntoon's letter to all affiliated clubs, citing his distortions and outright lies.

RTTY Rule Change

The RTTY contingent will be happy to know that the FCC finally has modified the dual identification regulation slightly. Now it is no longer necessary to send the call of the station you are working on CW at the beginning and end of each QSO . . . just your own call. This simplifies things for a code wheel or short tape will permit this CW identification without the necessity of hand keying. This rule holds for amateur television and facsimile also.

Intruders

The Institute of Amateur Radio is encouraging a crackdown on non-ham use of our short wave bands. I am happy to report that several amateurs in Atlanta have been sending reports to the FCC of reception of foreign interference. One was identified as a Yugoslavian point-to-point radiotelephone station and the FCC sent a radiogram requesting assistance to Belgrade. Another was identified as Radio Saracay in Ecuador. Quito was notified. A third unwanted signal turned out to be the second harmonic of a station in Mexico City. Mexico was advised.

When you hear intruders in our bands do your best to identify them and then report this to your nearest FCC office. I'd like to hear about any successes. With diligence we can get the great bulk of these intruders out of our bands. . . . Wayne

(Receiver from page 52)

To maintain a constant *if* bandpass with varying signal conditions, no AGC is applied to either of the 85 kc *if* amplifiers. If AGC was applied to these transistors, output and input impedance changes with collector current would produce a varying bandwidth with varying signal levels.

The output of the 85 kc *if* strip is coupled through the output transformer secondary to the detector circuits.

Detector, AGC, and Noise Limiter Circuits

Separate detectors are utilized for receiving AM and SSB, CW signals. The use of a separate detector on SSB overcomes the problem of nonlinear detection under strong signal conditions.

The AM detector consists of a conventional series diode whose output is fed to a series noise limiter circuit.

The SSB-CW detector consists of Q_9 and Q_{10} operated as a product detector. The output of the *if* strip is coupled to the base of Q_9 which shares a common emitter resistor with Q_{10}. Carrier injection is applied to the base of Q_{10} and in this stage is mixed with the *if* signal developed across the common emitter resistor. Audio, carrier injection oscillator, and *if* appear at the collector of Q_9 and Q_{10}. A low pass filter immediately follows Q_{10} and passes only the audio frequencies to the audio amplifier. The frequency of the carrier injection oscillator, Q_{11}, is variable and may be used as a pitch control when receiving CW signals.

AGC voltage is taken from a point immediately following the diode detector and applied to the base of Q_{17}, the combination AGC amplifier and S meter amplifier stage. To minimize loading of the controlled stages on the AGC line, Q_{17} operates as an emitter follower and provides a low impedance point from which the AGC voltage is derived. The emitter resistor of Q_{17} is variable and functions as an rf gain control if manual gain control is desired. The signal strength indicator, a 0-1 milliamp dc meter, is connected in the collector circuit of Q_{17} and indicates any change in AGC voltage. When using manual gain control, the S meter is switched out of the circuit. This S meter circuit suffers the same limitations that are inherent in all vacuum tube S meter circuits, namely nonlinearity and varying readings on different bands due to gain changes. Since the gain of transistors changes nonlinearly with current, and since changes in input and output impedances with current produce varying losses in the tuned circuits associated with the controlled stages, the design of a linear reading S meter circuit becmes a very difficult, if not impractical, task to undertake. The S meter, therefore, was calibrated to agree with the nonlinear AGC characteristic of the receiver. While the AGC characteristic is nonlinear, a plot of AGC voltage versus signal strength should yield a smooth curve; otherwise, the S meter calibration would be quite random. To achieve this smooth characteristic, it was found necessary to have the gain of all controlled stages changing at approximately the same rate. This was achieved by biasing the emitters of Q_1, Q_2, and Q_4 from the voltage dividers as explained earlier in this paper.

The noise limiter consists of a conventional series diode which is self-adjusting to different incoming signals and was set to clip at approximately 30% modulation.

Audio Amplifier and Power Supply Circuit

The audio amplifier circuit is a conventional Class A, common emitter stage, Q_{12},

Table 1

Band	80	40	20	15	10	All	Units
SSB Sensitivity for 10 db S+N/N						< 0.3	µv
AM Sensitivity for 10 db S+N/N	0.8	0.7	0.8	0.6	0.7		µv
Gain Variation	0 (ref)	−2	−4	−3	−7		db
1st if Image Rejection	60	60	60	50	50		db
2nd and 3rd if Image Rejection						> 60	db
Spurious Response Rejection						> 50	db
Rf Overload at 30% Modulation						30K	µv
Rf Overload at 80% Modulation						15K	µv
AGC Figure of Merit						85	db
IF Bandwidth 6 db Down						1.5-6	kc
Audio Output Power at 10% Distortion						2	watts
No Sig. Current Drain						75	ma
Antenna Input Impedance						50	

driving a push-pull amplifier, Q_{13} and Q_{14}, capable of two watts of output power at 10% harmonic distortion.

The power supply consists of a full wave rectifier and a transistor regulator. Regulated voltage is applied to all stages with the exception of the audio output. Receive standby switching is accomplished by removing the supply voltage from all stages except Q_2, Q_3, Q_6, and Q_{16}. These four stages derive their voltage from an additional regulator diode for the purpose of providing additional frequency stability to the receiver. The regulator transistor operates on both 115 volts ac or 12 volts dc supplies.

The complete circuit of the receiver is shown in Fig. 2. As was stated in the introduction of this article, the objective of the design was to produce a receiver which would compete with today's top-of-the-line vacuum tube receivers. It is felt that this receiver more than meets these requirements. The advantages of transistors over tubes have been known for some time and include such things as reliability and small size. Unfortunately, most advantages carry along with them some disadvantages. In this case, the inability of the receiver to handle extremely large signals without overload might be considered a disadvantage. The large signal handling capability of this receiver was compared with its vacuum tube counterpart and found to be equivalent up to approximately 30 Kμv at 30% modulation. Above this signal level, the transistorized receiver exhibited more spurious responses than that of the vacuum tube receivers measured. This value of signal level is seldom encountered in practice and, therefore, this characteristic should have very little degrading effect on the overall operation of the receiver. The performance obtained from the completed receiver was excellent in every respect. Important performance characteristics of this receiver are listed in Table 1.

. . . Morgan

Attention mobileers: This receiver will give you good results for mobile operation but do not forget to add the standard protection (silicon diode) to the front end transistor or you will have to buy a new one every time you go to a mobile rally. . . . ed

Transistor List

Q_1	TI-365 or 2N2189	Q_{13}, Q_{14}	TI-369 or TI-368
Q_2, Q_4	TI-363 or 2N2189		
Q_3	TI-395 or 2N2188	Q_{19}	2N1304
Q_5, Q_6, Q_7, Q_8, Q_{18}	TI-364 or 2N2188		
Q_9, Q_{10}, Q_{11}, Q_{12}, Q_{15}, Q_{16}, Q_{17}	2N1274		

The TI-numbered transistors will give optimum results. They can be ordered through any Texas Instruments distributor.

73 Products and Publications

6UP Magazine. The only fullfledged monthly devoted to VHF. Invaluable to the Technician and the VHF/UHF DX'er and experimenter. Activity reports on all band openings. Wide band FM news. Six meter news. Two meter news . . . 220, 432, 1296 . . . etc. Construction articles, antennas, etc. K5JKX editor. **$2 per year.** Don't miss a single copy of this interesting magazine.

ATV Bulletin. The Amateur Television Experimenter is the only publication devoted to ham-TV. Circuits, operating news, conversions of surplus gear, ads for TV gear, discussions. WØKYQ editor. $2 per year, published bimonthly.

Back Issues of 73. All back issues of 73 are available for **50c each** except June 1962 and January 1961, which are unavailable, and Oct-Nov-Dec 1960 issues, which are $1 each. We'll *pay* $1 for a January 1961 or swap for it.

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Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

73 Inc

Peterborough, N. H.

Diode Tester

Don Hansen W9ZZH

Need a simple go-no-go diode checker? Fig. 1 shows the schematic of a tester that will check most of the diodes used by radio amateurs. It consists of a 6.3 volt filament transformer, a SPST switch, two 1N34A diodes, and two number 48 or 49 panel lamps. The number 48 and 49 panel lamps have a voltage rating of 2 volts and a current rating of 0.06 amps. The number 48 panel lamp has a screw base and the number 49 panel lamp has a bayonet base.

To test a diode, connect it across the test terminals (observe polarity). Turn the power switch to on. If only lamp I_1 lights, the diode is good. If only lamp I_2 lights the diode is good except it is reversed in polarity. If both I_1 and I_2 light, the diode is shorted. If neither I_1 or I_2 light, the diode is open.

. . . W9ZZH

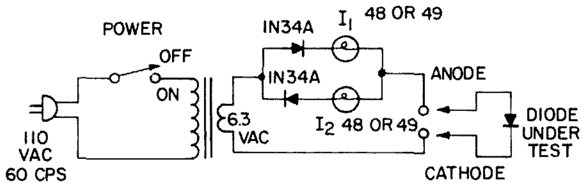

FIG. 1

Gonset on CW?

The old Gonset Communicators were fine rigs for AM, but are useless for CW and SSB. However, it's not too hard to modify them so that they will do an adequate job on CW and on sideband signals that aren't too strong. Plug a 6000kc crystal (obtainable from International Crystal in Oklahoma City) into the crystal socket and turn on the spot switch. The 6000 kc carrier will beat against the signal at about 6000 kc, and you can copy the desired signal. Needless to say, the crystal can be anything from 5995 to 6005 kc and still give good results. If desired, the *if* can be peaked about 1.5 kc away from the crystal frequency on a steady carrier for best results.

. . . WA4HWH

Subscriptions

If you like 73 we'd appreciate your help in getting more fellows to subscribe. The big difficulty is to overcome inertia and actually get them to sit down to get it done. We try to make it as simple as possible on our end. The price is a simple (and low) $4. Our address is simple: 73, Peterborough, N. H.

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New Ham Shire

NEW NEW NEW
REVISED INDEX TO SURPLUS—W4WKM This is a complete list of every article ever published on the conversion of surplus equipment. Gives a brief rundown on each article. Revised through June 1964. **$1.50**

2—SIMPLIFIED MATH FOR THE HAMSHACK—K8LFI.—This is the simplest and easiest to fathem explanation of Ohm's Law, squares, roots, powers, frequency/meters, logs, slide rules, etc. If our schools ever got wind of this amazing method of undestanding basic math our kids would have a lot less touble. **50c**

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109—AMATEUR RADIO TOWER INSTALLATION INFORMATION—published by Rohn. Nearly 100 pages of info on selecting, buying and setting up towers for amateur radio. While this book is one of the most complete catalogs of Rohn towers ever published, it also has all the instructions you could possibly want on installing your tower. Lots of good color pictures. Well worthwhile. **$1.25**

11—16TH EDITION RADIO HANDBOOK—by Bill Orr W6SAI. This fantastic book is loaded with the most understandable theory course now available in our hobby plus dozens of great construction projects. This is the best ham handbook in print by a wide margin. Easily worth twice the price. **$9.50**

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6—SURPLUS TV SCHEMATICS.—You can save a lot of building time in TV if you take advantage of the real bargains in surplus. This book gives the circuit diagrams and info on the popularly available surplus TV gear. **$1.00**

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Radio Handbook, 15th Edition, written by Bill Orr W6SAI, over 800 pages. Covers every phase of amateur radio from the very basics right up through the construction of just about everything you could want in ham gear. Originally published at $8.50. Superceded by the new 16th edition which is the same except for new construction projects and selling for $9.50 (see number 11). Special, until the last few copies are gone, only **$5.95!**

28—TELEVISION INTERFERENCE—Rand (W1DBM). This is the authoritative book on the subject of getting TVI out of your rigs and the neighbors sets. **$1.75**

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7	7*	14	14
ARGENTINA	14	14	7	7	7	7	14	14	14	14	21	21
AUSTRALIA	14	14	14	7	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	14	14*
ENGLAND	7	7	7	7	7	7*	14	14	14	14	14	14
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7	7	7	7	7	7	14	14	14	14	14	7*
JAPAN	14	14	7	7	7	7	7	7	7	7	7*	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	7	7	7	7	7*	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	14	7*
U. S. S. R.	7	7	7	7	7	7	7*	14	14	14	14	7
WEST COAST	14	14	7*	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7*	14	14
ARGENTINA	14*	14	14	7	7	7	14	14	14	14	14*	21
AUSTRALIA	14*	14	14	7*	7	7	7	7	7	7	14	14
CANAL ZONE	21	14	7*	7	7	7	14	14	14	14	14	21
ENGLAND	7	7	7	7	7	7	7*	14	14	14	14	14
HAWAII	14	14	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	7	7	7	7	7	7	7	7*	14	14
JAPAN	14	14	14	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7*	7	7	7	7	7	7	7	7*	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	14	14	14	14	14	7*
U. S. S. R.	7	7	7	7	7	7	7	7	7*	14	14	7

WESTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	7	7*	7*
ARGENTINA	14*	14	14	7	7	7	7	14	14	14	14	21
AUSTRALIA	14*	21	14	14	14	7	7	7	7	7	14	14
CANAL ZONE	14*	14	14	7	7	7	7	14	14	14	14	14*
ENGLAND	7	7	7	7	7	7	7	7	7	7*	14	14
HAWAII	14	14*	14	14	7	7	7	7	14	14	14	14
INDIA	14	14	14	7	7	7	7	7	7	7	7*	14
JAPAN	14	14	14	14	7	7	7	7	7	7	14	14
MEXICO	14	14	7*	7	7	7	7	7*	14	14	14	14
PHILIPPINES	14	14	14	14	7	7	7	7	7	7	7	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	7	7*	14	14	14	7*
U. S. S. R.	7	7	7	7	7	7	7	7	7	7*	7*	7
EAST COAST	14	14	7*	7	7	7	7	14	14	14	14	14

* Means next higher frequency may be useful.

Good: 10-13, 15-20, 24-26

Fair: 7-9, 14, 21, 23, 28-31

Poor: 2-6, 22, 27

Es: 14-16, 25-26

(High MUF and/or freak conditions)

J. H. Nelson

73

Amateur Radio

SEPTEMBER 1964
A Picayune 40c

HB9RF
See page 62

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

September, 1964

Vol. XXIII, No. 1

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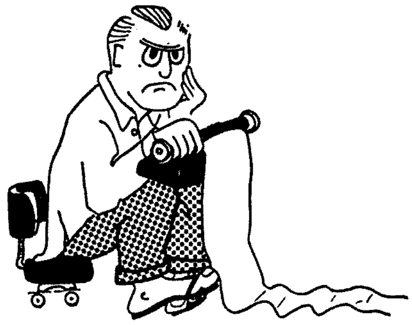


de W2NSD/1

never say die

Do It Yourself?

In all of the tumult over incentive licensing, there is one item that seems to be generally accepted: it would be nice if things were better. We all wish that operating in our lower bands wasn't quite so hectic, that more operators would be considerate, that more public service was being accomplished, that more of us would try building equipment and that we would all continue to improve technically. Not necessarily in that order.

All of these goals are worth tackling. Amateur radio will be the better for their success and our enjoyment of it will be just that much more enhanced.

The question is, shall we go after these objectives voluntarily, putting our own personal enthusiasm into them, shall we do it with a gun stuck in our back, or shall we just leave everything alone and let things fester?

My own belief is that we can accomplish all this ourselves without the FCC wielding a big stick.

Ham radio is one of the greatest hobbies in the world. Not only do we get entertainment from the use of it, but we are ready to help out in any emergency or disaster. Perhaps it is time that every one of us took a good deep look into ourselves to see what we can do to be a better amateur and to make amateur radio better. This means all of us, from the oldest old timer to the newest Novice. All of us can help ourselves and ham radio.

What can *we* do? Let's take another look at those goals:

Courtesy
Wider use of available bands
Technical improvement
Home construction
Public service

Courtesy. Perhaps consideration would be a better term. All of us can devote time and effort to this, not only in being sure that our own behavior is impeccable, but in teaching others what is right and what is wrong on our bands. It takes great courage to speak up when someone has done wrong . . . and great diplomacy. Diplomacy is not a born ability, it is learned through bitter experience. I find that few fellows get angry when I suggest an improvement in their equipment or techniques. I believe that the single greatest improvement possible to ham radio would be universal consideration.

Bands. To all practical purposes there is no QRM on the six and two meter bands. Neither is there any lack of activity. If you'll give them a try you'll find quite a few refugees from the furies of 20-40-80 up there. Ten needs you too.

Though all of these goals can be reached on a personal basis, many of them can be more effectively implemented through the group effort of an amateur radio club. Group action is the backbone of our hobby. Very few amateurs live beyond driving distance of a ham club. If every amateur would make it his business to attend club meetings and encourage his club to achieve the above goals we would enter a new era in our hobby.

Club discussions of operating practices are certain to be lively.

A club channel on ten, six or two would certainly open new horizons for many of the members stranded in the jungles on 75 or 20. Group efforts might even get activity going on 432 mc, which is increasing in popularity rapidly these days.

Every club meeting should include a short technical session where some phase of radio is discussed. The technical topic can be as-

signed at the previous meeting and should be something that all members can bone up on . . . perhaps a technical article in QST or 73. Clubs that are interested in using any of the many such technical articles published in 73 can buy bulk copies of back issues at our cost plus postage. That's the least we can do. You'll find a list of suggested issues on page 86.

Club projects for building identical units is fun and profitable. The club can take advantage of bulk buying savings . . . individual members can be sure that there will be someone to help them out of self inflicted difficulties. Turn to the back issues and handbooks, fellows. Construction is considered by many as one of the most exciting aspects of amateur radio. How about giving it a try?

Public service is easy. Club members should be able to come up with more suggestions than you can ever tackle. And don't forget to toot your horn when you turn in a good job . . . write an article for the local paper.

Tithe

Your excuse is the same as mine, I just don't have time. What little time I have to spare I like to use to get on the air. This is just an excuse, a rationalization. Actually there are darned few of us that cannot spare one night a month to attend a club meeting . . . and fewer yet that cannot spare a half hour or so a week to do some building and technical reading. If a fellow isn't interested enough in improving ham radio so that he is willing to invest one tenth of his hobby time in our common goals, how valuable an asset is he to the rest of us . . . or to his country . . . or to himself?

Please give some serious consideration to devoting a tithe of your time to bettering yourself and amateur radio.

Big Blow

One of the club events of which I most highly approve is the yearly "Big Blow" by the Windblowers VHF Society. This Northern New Jersey group takes to the mountains once a year for a day and sets up two meter stations in four states. If you can work all four of them you get a nice certificate. This year you'll hear the Blow on September 26th from 1400-2400 hours EDT, operating from New Jersey, New York, Pennsylvania, and Connecticut.

Current Events

No news is bad news on WA2USA.
No news is good news on RM-499.
No 73 at the ARRL National Convention.
Letter from K1YVB saying he was not per-

(Turn to page 91)

Low Cost Linears for the Two'er

Bill Hoisington K1CLL
83 Bellevue Ave.
Melrose, Mass.

The extreme UHF capabilities of the 100 watt 2C39, "Full power to 2500 megacycles," certainly justifies its use at 432 mc but does keep the surplus price up between $5 and $10. This perhaps does not coincide too well with the economical concept of the Two'er.

Contacts on the air with the Two'er linear, however, have demonstrated a *very* large interest in such an addition providing it can be done at reasonable cost. So the search and work was started—with interesting results.

The first trial was a logical one. Your presnent writer back in 1946 ventured into print in QST with "Getting Started On 420," using the 8012-8025 tubes. This little red-hot (temperature-wise) bottle had at least one interesting feature. I worked on 420 mc! You could run a good 50 watts to it. You can buy it today for 50 cents. Let's see why.

The 8012-8025 Tubes

The 8012 has three flexible leads for the filaments and center tap, and two grid leads and two plate leads. These last are what counts on 432 mc, and do no harm on 144

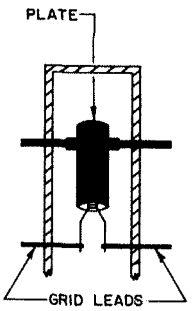


FIG. 1

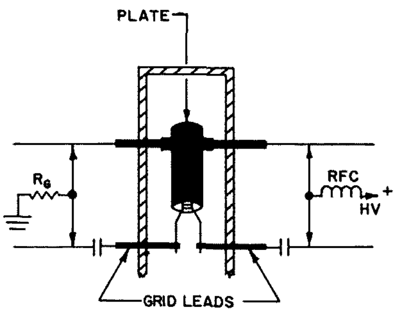


FIG. 2

Fig. 1—8012 double lead detail
Fig. 2—8012 double line UHF oscillator

mc either. The principle of more than one lead is a great one as you go up into UHF. Certain low-cost tubes use this feature to get to UHF. The 6AM4, 6AN4, and 6AF4A, among others. As an example of the effect of multiple leads, one of those tubes was being used as an oscillator with grid and plate lines of heavy copper wire. Just the addition of a second wire, in parallel with the first one was enough to jump the frequency from 400 to 600 megacycles.

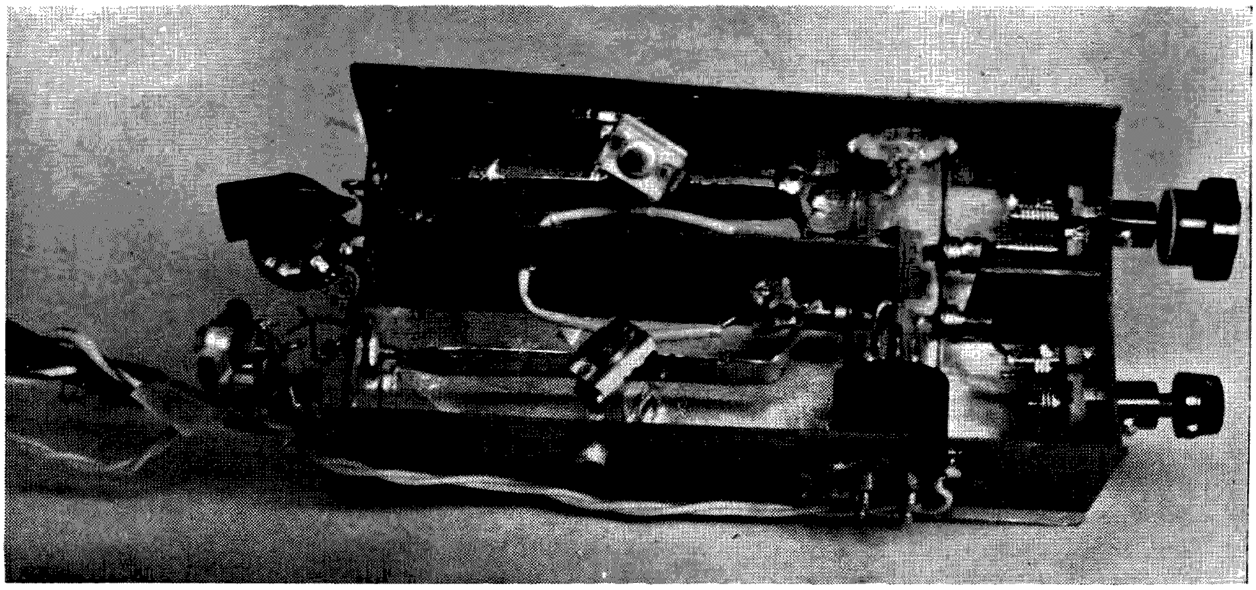
The configuration of the 8012 (see Fig. 1), shows this capability also, with it's two plate and two grid pins.

Fig. 2 shows how this may be used to advantage at UHF, as an oscillator. With lines on both sides, it would go to 500 megacycles. With lines on only one side you're stuck on the 220 mc band.

On two meters, Fig. 3 shows what can be done as a "rugged" 2 meter linear amplifier. Unfortunately the required drive power for this tube is not to be found in the Two'er. Fig. 3 works FB, but *not* with the Two'er as a driver. It neutralizes and tunes great, but the 8012 tube gain was not sufficient to operate successfully on the less-than-one-watt of rf from the Two'er. As they said in Paris, my residence from 1927 to 1934, "On a pour son argent." Literal English: "One has for one's money." So much for the 8012 today and it's twin the 8025, dressed up with buttons and a 4 pin base for the filament.

The 815

So on we went, the choice getting narrower and narrower. The tube must be *good* on 2 meters but not expensive. It should not, if possible, be described in the RCA Technical series as "This tube is used principally for



renewal purposes." Or worse, "This is a discontinued type listed for reference only." Regardless of the tube manufacturers reasons for not pushing a good tube like the 815, among which may well be the desire to sell more $20 double pentodes, there appear to be as many as one hundred thousand or more young lads who just *cannot* pay such prices but who *do* want some *power* on VHF-UHF!

What does RCA say about the 815? First, "Twin Beam Power Tube." This sounds good. What does it mean? The twin part is easy. There are two identical tubes in one glass envelope. They may or may not have some common elements. The 815 does.

How about the "Beam Power" business. This is real tricky but it sure helps! In non-beam power tubes, tetrodes or pentodes, some of the available electrons are collected by the *screen* and thus do not produce power at the plate. In beam power tubes the grid and screen wires are so arranged that most of the electrons pass ***between*** the screen wires on their way to the plate. These negative charges, on which the entire electronic world depends, do not put any energy into the plate tank and thus on into your antenna when they stop and chew the fat on the screen! Nuff on that. Next.

"May be used at full input to 125 mc."

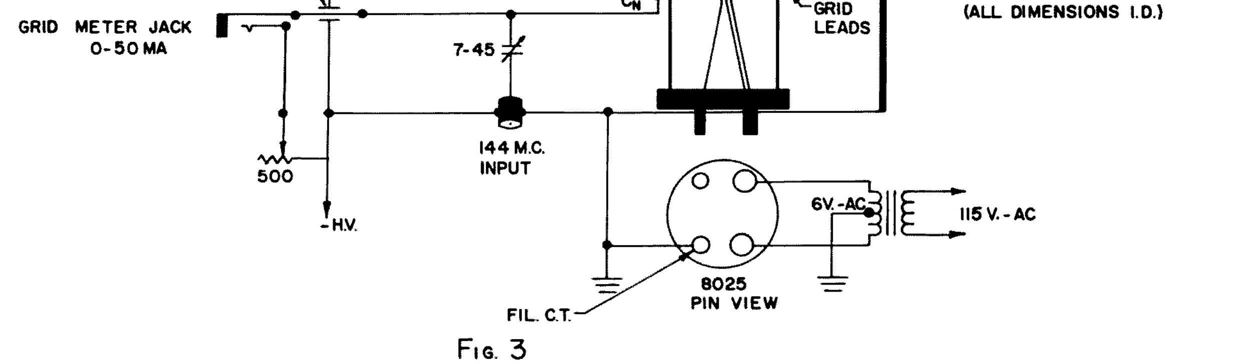
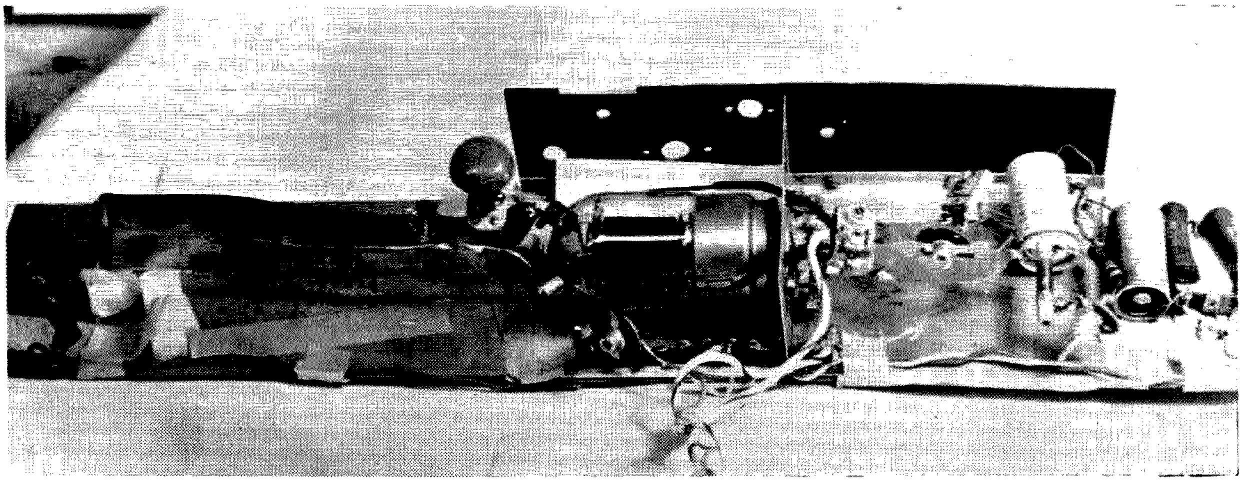


Fig. 3

8025 linear amplifier, 144 mc



"For operation at 175 megacycles plate voltage and input should be reduced to 80% of maximum." Looks like about 90% for 144 megacycles. Ratings for 200 mc are also shown, which is good, because listed operation at 200 mc means better capabilities at 144.

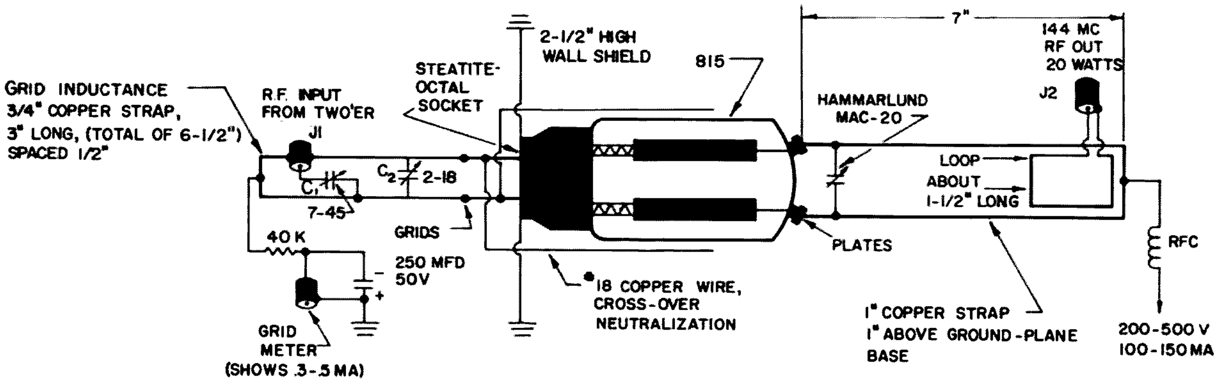
The allowed wattage looks good too. 75 watts input. More than we need but it's nice to have a little reserve. As a matter of fact, due to "grid circuit losses" and other nasty little deals, that 75 watts is *not* more than we need!

What about driver power? As a class C amplifier it works on only .16 watts! As a class AB2 job which is close to the desired class B linear type, .36 watts is indicated. And output? Using more drive than the Two'er has, I have lit a 50 watt bulb to full brilliance on 144 mc. So relax and lets' see what it actually *does* put out when driven by a Two'er.

Fig. 4 shows the pictorial basic diagram. Copper strap is used in the grid and plate lines for the maximum electromagnetic momentum effect. The more copper you can use *properly*, the more momentum you will have. Which helps FB to get a high Q.

Experience has shown that the Q of a pair of lines in a ½ wave circuit can be raised by locating them near a "ground plane," or in this case, a flat copper-clad sheet. The 815 socket can be located flat on a vertical wall on the copper-clad base. Grounds, filament, and screen bypasses, etc., are soldered close to the socket.

A good grid circuit is obtained with the ¾ inch wide copper strap which is needed to serve what little input power you get from



NOTES:

1. J1 OUTER CONDUCTOR CAN BE INSULATED WITH SMALL 1000 MMF DISKS IF NECESSARY.
2. GRID BIAS ABOUT 15 VOLTS.
3. SEE FIGURE 5 FOR SOCKET DETAILS.

FIG. 4

Fig. 4—Top view, 815 double beam-power pentode, 144 mc linear amplifier
Note 1: Ji outer conductor can be insulated with small 1000 mmfd discs if necessary. Note 2: Grid bias about 15 volts. Note 3: See Fig. 5 for socket details.

"SS-1R . . . . . in a class by itself"

DOUGLAS MICROWAVE CO., Inc.

252 EAST 3rd STREET • MOUNT VERNON, N. Y. 10550 • 914 MOunt Vernon 8-6900

CABLE – DOUGMICRO

June 3, 1964

Mr. Richard Marder, Sales Manager
Squires Sanders Inc.
475 Watchung Avenue
Watchung, New Jersey

Dear Mr. Marder:

I have now had my SS-1R (and SS-1S silencer) for a month and can now evaluate it, both from an operational as well as from a purely technical viewpoint. There is no question in my mind that the SS-1R is so outstanding that it is in a class by itself. In all my years as a radio "ham", going back to 1932, I have seen (and used) the "latest and newest", from the simplest (SW-3), to the HRO, to the Super-Pro, to the present Collins line. The SS-1R is as far ahead of them all as to be in a class by itself. This is one time when the expression "Sales is two years ahead of engineering" definitely does not apply; your engineering department is years ahead of your sales department. In my opinion you do not extoll strongly enough the real advantage of the SS-1R over anything else presently available. I am referring, of course, to the superb anti-cross-modulation front end design.

Having the good fortune (?) to be surrounded, within a radius of one mile, by at least three 20 meter, single sideband 1 Kw stations, I had been plagued by unusable wide sections in the band whenever these stations were on. I can honestly state now that the only time I am troubled with them is when I tune to within about 10 Kcs or less of their frequency.

It almost goes without saying, but, nevertheless, I must comment on the digital readout dial, the frequency stability and the ease of tuning; the receiver is superb and outstanding in all these features.

I have saved my comments on the noise silencer for the last. I recall, wayback in the late '30s, watching and hearing Jim Lamb demonstrate his I.F. noise limiter. In the twenty-odd years since then I had never seen (or heard) a noise limiter, clipper or silencer to better his original design; your SS-1R and SS-1S have now revised this opinion, but definitely! Again I feel your advertising of this feature is understated.

Being blessed with a good R.F. laboratory which makes it possible to check out equipment over the frequency range of 5 cycles to 90 Kilo megacycles (90 Kmcs), it was with a great pleasure I saw the results when I ran the receiver through its paces: signal to noise ratios were met easily; dial accuracy was exceeded (averaging 1/4 to 1/2 Kc error, but never getting close to your stated 1 Kc max. error); frequency stability, as measured with a Hewlett-Packard counter, never exceeded a maximum of 80 cycles, from a cold start over a two hour "warmup" period.

In conclusion, I leave you with this thought: If Collins is considered the "Cadillac" of receivers, your SS-1R should be considered the "Rolls-Royce".

Very truly yours,

DOUGLAS MICROWAVE CO., INC.

Harry Douglas

R. Harry Douglas
President
W2VRU

RHD:jr

P.S. Very Important-Please rush through the SS-1T transmitter; I am anxious to put it on the air.

Squires-Sanders, Inc.

475 WATCHUNG AVENUE, WATCHUNG, N.J.

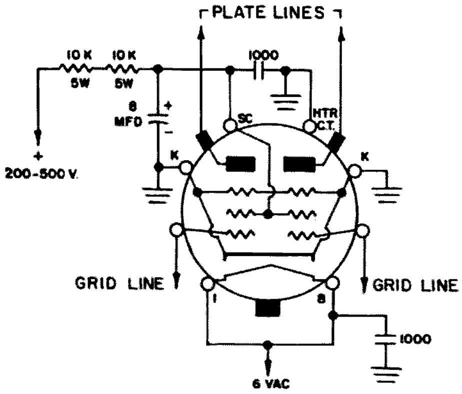


FIG. 5

Socket details, 815

the Two'er, because after all, it *is* a limited output unit. Three inches on each side for the grid line is not bad at 144 megacycles, considering the listed 13.3 mmfd input capacity of the 815 and the parallel tuning used.

Grid bias of minus 15 volts is listed for class AB2, and this just about what we wind up with finally. Putting a very large capacity across the grid resistor takes care of a sufficiently "stiff" bias for an AM linear, to an astonishing degree. My first contact with this amplifier was in West Bath, Maine, some 135 away Down East, airline miles. He reported, "Modulation very fine. Filling carrier. Even in deep fade to noise could still read you." I was running about 20 watts out then. After all, this is just a single $1.75 tube driven by an unmodified Two'er.

The screen is a nice place for a power control if you would like one. Put a high power pot (five or ten watts rating) in place of the screen resistor indicated. Actually what are we worrying about? At these power levels? Tee Vee's run 200 to 300 watts all day long with—in my opinion—morons watching them for the most part, so the 40 to 50 watts input of our little "booster" linear is OK for my money. After all, it does operate around 60% efficiency on maximum Two'er modulation. SSB linears call for a "stiff" screen supply voltage. Do we need one here? Let us see just how rigid this must be for an AM linear which does *not* operate in the same fashion as an SSB linear. Checking the screen voltage under modulation with just an 8 mfd to ground for regulation, we find practically no variation in voltage. It should be remembered that in an AM linear stage with symmetrical modulation voltage, the average plate current remains constant. The proper positioning of the drive and bias is more important here, as we will see, although the whole rig appears remarkably *uncritical*. In fact, as you listen to it while varying screen voltage and grid bias, there isn't much difference. The rf drive has perhaps the greatest effect. I finally settled for 20K series resistor in the screen; putting 190 volts on it with 450 volts on the plate and 40K in the grid, which puts some 12 to 15 volts bias on it. Again, remember that information on how to operate a linear for SSB does not apply here. That is, not *all* of it. In SSB, no rf is applied (if your carrier is really suppressed) til you talk. With an AM linear the carrier is always there.

As shown "flat-out" the unit is some 15 inches long. The plate lines may be run back over the tube if a good shield of copper-clad bakelite is installed over the tube and under the "bent-back" plate lines (not shown). In this case the length could be kept under 8 inches. If you really want to make it small, this can be done, but the Q, output, and rf filtering effect may drop a little.

A diagram of two-switch send receive operation is shown in a previous section in the 2C39 linear article.

On the Air Tests

Settling down with a steady 20 watts output, driven by the unmodified (as-yet!) Two'er into the little 4 element beam, results were almost identical to operation with the 2C39 linear. "Modulation sounds excellent"; "If I had a Two'er I would get right to it"; "Sounds great."

Personally, I'm getting quite interested in trying this rig out mountain-topping, my favorite recreation.

. . . K1CLL

Letter

Dear Wayne:

Perhaps I missed the corrections, or perhaps you missed the errors.

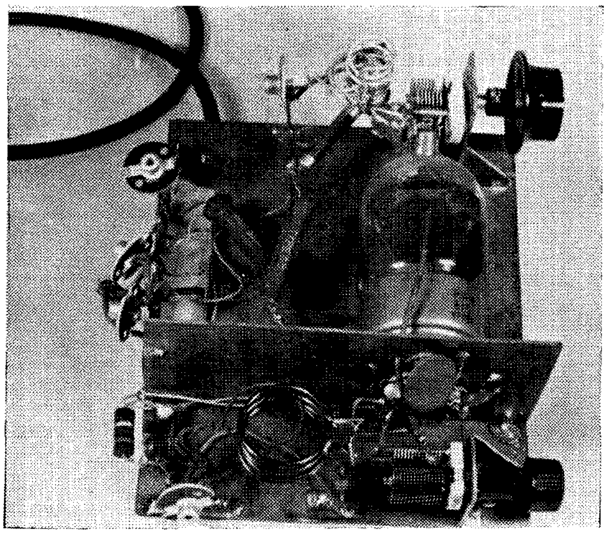
In the article "Let's Keep It Simple" (Jan. '64), the 100 microhenry choke should connect to the collector rather than the emitter. This was compounded by VE2AUB's statement that "the circuit may appear strange at first." Hi. A similar circuit appeared in "Hints & Kinks" a while back. For me, both circuits had the same defect. The crystal signal seems to swamp the signal from the antenna. Any suggestions?

In the sweep generator article "A New Broom" by K6JHJ (May '62), the oscillator grid leak was omitted. Anything else?

A very practical accessory for the "Broom" can be found in the Oct. '61 issue of "CQ." A two tube logrithmic amplifier and detector circuit can be "lifted" from the "Spectrum Analyzer" by K2BAJ and W2QZJ.

Gordon C. LaGrange, W5AKQ

The Sixer Linear



Bill Hoisington K1CLL

Design Philosophy AM Linear Operation

We will plunge right into the thick of AM linear theory without delay because I feel that the young starting out amateur (I was one once, too) has been had on this question. For the life of me, I can't understand why, but maybe you can form your own conclusions. Let's see.

Most of my amateur life I have shied away from AM linears because "everybody" said they were "only 30% efficient." It wasn't until I really delved into the subject recently and actually built several on 2 meters and on 6, that I began to wonder "what cooks here?"

Starting in naturally with "The Radio Amateurs Handbook," there is about two columns on the linear AM amplifier to be found on pages 296-7. What does it say? "The plate efficiency of the amplifier (linear AM) varies with the instantaneous value of the modulation envelope. The efficiency at the unmodulated carrier level is only of the order of 30-35%." "Because of this low efficiency, linear amplifiers have not had much application in amateur transmitters, ...". ". . . . . and only about one-third (of the input power, dc) is converted to useful carrier output."

There are some odd things about the above. The part about the 30% is true, but *only* for an unmodulated carrier, which "Who needs?" The second part is an opinion only. The fact is, a "sin of omission" has apparently been committed, for many long years.

For example, what does Terman say? "The linear amplifier is a form of Class B amplifier, and its most important use is as a power amplifier of modulated waves." Now read the next *carefully*. "The plate efficiency at full output is usually of the order of 50 to 65 percent under practical conditions. The peak power that can be developed by a tube operating as a linear amplifier is approximately the same as the power that can be developed by the same tube in class C operation." At about this point I began to realize the "why" of some of the on the air reports I had been getting. Any more? Yep! "The linear amplifier is a class C amplifier modified by adjusting to make the output proportional to the exciter voltage. Such amplifiers are used extensively in the amplification of modulated waves since they preserve the modulation without distortion." Well! Also, no wonder! "With the maximum allowable excitation the plate efficiencies of linear amplifiers normally lie between 50 and 65 per cent . . . .". So that's why I got those reports on the air! Any other "Authorities" on the subject? Yes. The Radio Corporation of America puts out a useful little tome, "Technical Manual TT5." This handbook "will be useful to engineers, ... amateurs, and many others technically concerned with transmitting tubes." On page 19 we find ". . . class B amplifiers are particularly suitable for use as output amplifiers employing "low-level" amplitude modulation." ". . . the maximum efficiency varies from approximately 33% for an unmodulated carrier, to approximately 66 per cent for a fully modulated carrier."

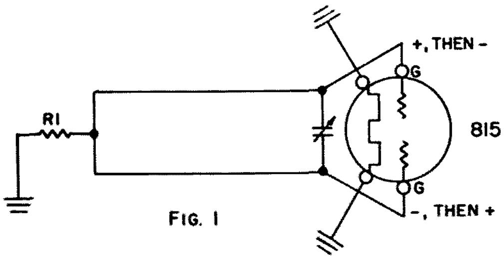


FIG. 1

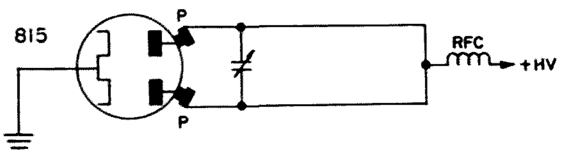


FIG. 2

Without further ado let's get on with the deal and look at the electricity consumed, cost, what tube, circuit, and on the air reports. You can judge for yourself, it won't cost you much.

Just wait till you hear some beefed-up Sixers on the air, if you haven't already. I was astonished myself and my first license was dated 1921, 2BAV. Wait till I go mobile and mountain-topping with *this* one!

Furthermore, as you will see, "automatic" class B can be used, without any regulated supplies at all. The rush to SSB by some people has greatly confused the linear amplifier question also, aided by some who have not seen, or don't care to see, the difference between a linear with an SSB driver, and a linear with an AM driver.

The handbooks are full of SSB linears. In the author's desires to find and be identified with new equipment, and to show off his erudition, he fills pages with descriptions of how to "tame" certain new tubes, what high voltage to use, how to obtain carefully regulated screen and bias supplies, how to suppress all kinds of "parasitics," regeneration, etc., in order to get "stability," without which he states, linear operation is "impossible." With certain popular type tubes a lot of this *is* needed for SSB, but not for an AM linear.

Cost

A persistent topic of typical VHF rag-chewers today concerns the absence of good low-cost rigs in the 50 to 75 watt class for the developing VHF amateur of the do-it-yourself type. These are for the young lads who save pennies, not dollars, until they get enough to send away for a Sixer, (personally I hope they send for a Two'er, since that's my favorite band) or maybe a used Gonset for six meters. They would like quite a bit more power if they could afford it. Several things get in the way though. First, what to buy, or build.

What to Build

Here there are all kinds of choices, generally leading into high voltage, an expensive modulation transformer, and what final? Well, to put your mind at rest right now, there is a tube selling for $1.75 that can do the job practically all by itself, without a modulation transformer and with a reasonable HV supply of some 300 to 400 volts. This is the 815 Beam Power Double-Pentode run as an AM linear. It is a "surplus tube." It is a well tried design and one I used on 5 and 2½ meters before World War II, to be strictly honest. What happened to it? WW 2 came hurrying along, driven by the mad paper-hanger, and the 832 and the 829 were rushed into being and served well in the Armed Forces.

The 815, with its slightly reduced rating at 144 mc, took a back seat and apparently has stayed there. However, it still is *not* listed as "For renewal purposes only" or "discontinued type." Briefly, it is listed at 25 watts dissipation and will put out a good 25 watts also, cool. Being a double tube with parallel dc operation, it does this with voltages (300-400) that can be obtained from a power transformer from almost any old Tee Vee box. I found several of these recently that had been thrown away! Suit yourself on that.

The 815 is one of the first, successful Twin Beam Power tubes. The heater is either 6 or 12 volts, which is handy for mobile. It has an octal socket which is good because low cost, and because the plates are on the *other end* of the tube with two plate caps.

This business of single-ended versus double-ended tubes has been played up and down across the radio world for many decades. I used to use the 201A back in 1925-26. Then you could work ZL's and such using a single tube receiver (with the 201A) and a single tube transmitter. I had a Western Electric 212B, with 2000 volts ac on the plate. Then people got rf amplifier conscious, and out came the type 24 tube, double ended. Then a little later on the service people kicked about handling plate or grid caps as well as shielding, and an ever-growing family of single-ended tubes started up again. Now they had trouble with feedback from grid to plate, and various little tricks were used, like a center pin type shield, sockets with a little shield in the middle, building a shield out of mica capacitors across the socket, etc. As far as any power was concerned, except maybe for straight audio, transmitter tubes were still double-ended, like the 815.

The 815 is somewhat like two good 6L6's in one envelope with plate connectors on top,

common screen, common cathodes, with the suppressors internally connected to the cathodes. It has always been a good low voltage high current rf tube. The beam power is a name, and a good one for the use of grid and screen wires so lined up that most of the electrons reach the plate, and do not hit the screen on their way over. This is particularly useful just at the time it is needed most. That is, when developing power the plate should swing way down near zero. At that time the plate is more negative than the screen and electrons would tend to be more attracted by the screen were it not for the beam effect.

The formation of a "space-charge" helps too. This little electronic trick is a concentration of electrons near the plate, which being negative, (the concentration, that is) tends to repel secondary electrons from leaving the plate. If electrons left the plate it would go positive just at the time you want it to go negative. These nuisance secondary electrons are the result of the primary electrons, the ones you get from the cathode and want to use, going "Hot-Rod," at some 67 million miles per hour, and hitting the plate at that speed, which causes "electron splatter" (I should think so!). Of course, you *want* them to reach the plate but you don't want the secondaries to leave the plate. When as many secondaries are leaving the plate as primaries are arriving, you don't produce much power!

There is a much more complicated and important deal that enters the picture too, even more so at UHF, but we will look deeper into that later on. This is the very great difference between the flow of electrons in a tube, at some fraction, say one twentieth, the speed of light for a plate voltage in the few hundreds, and the flow, or rather progress, or speed, of the electromagnetic *wave* along the plate strap, line, or cavity wall, which is practically at the speed of light.

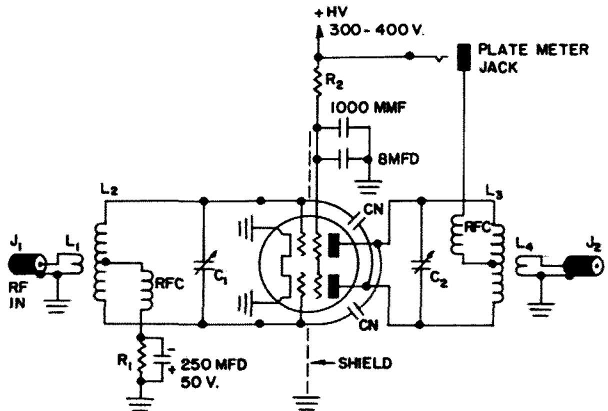


FIG. 3

L1 3 T interleaved near middle
L2 4 T heavy copper wire, #12 at least, ¾" long 1¼" O.D.
L3 6 T #14. 1¼" long, ¾" O.D.
L4 3 T #18, interleaved, ½" long, ½" O.D.
C1 & C2 50 mmfd Hammarlund MAPC-50B
Cn See text
R1 5K
R2 20K, 5W

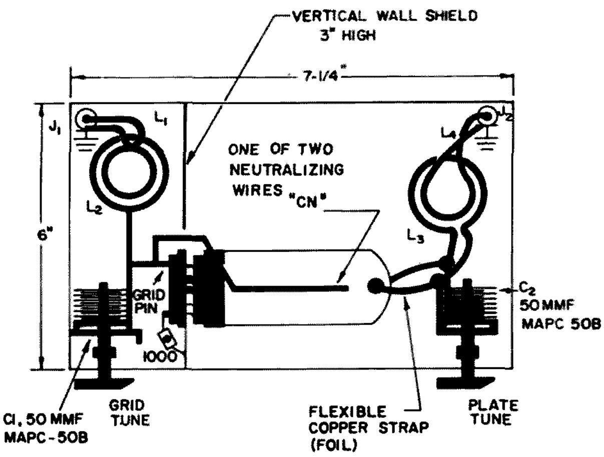


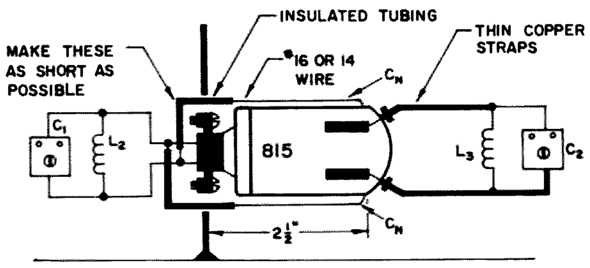
FIG. 4

L1 6 T #18, ⅝" long, ⅝" O.D.
L2 5 T #22, covered, ½" long, ½" O.D.
L3 2T #22, covered, closewound, ½" O.D.
L4 3T #22, covered, closewound, ⅜" O.D.
L5 3T air wound, 16 per inch, ½"
L6 4T #14, ⅝" long, ⅝" O.D.
Ln 4T #22 plastic covered, ⅜" O.D., ½" long inside L6
L7 2T #18 covered, ⅜" O.D., adjustable coupling to L6

So now we have the electrons at the plates of the 815, first on one plate then on the other, as the tube runs best in push-pull, and it really develops power. As mentioned, a good 25 watts output at 144 mc, or on 50 mc in this case.

Fig. 1 shows a big advantage of push-pull action at VHF. With a single grid the rf must be applied between grid and cathode. With push-pull the rf is applied to the two symmetrical grids, so that automatically there is a large and properly phased voltage between each grid and the cathode. The same effect applies to the plates, only more so, and a little different. As you can see in Fig. 2, electrons will arrive first at one plate then at the other. The electromagnetic wave, which is the type of energy you are interested in getting into the antenna and over to the other fellows antenna, travels back and forth on the U shaped inductance and does *not* have to be bypassed back to the cathode, as you can see.

Briefly, and exaggerating a little, for a 500 volt HV supply, first one plate gets a glop of electrons from the cathode as its grid goes toward positive. These negative charges cause the plate to drop near zero, providing of course that everything is working right, and also re-



NOTES:
1. CAPACITOR MOUNTING STRIP NOT SHOWN.
2. C_1, C_2, SEE TEXT.

FIG. 5

membering that it takes a certain number of rf swings to reach the point of operation. The next instant (rf-wise) the electrons stop arriving at that plate and it "bounces" back positive again. It does not necessarily stop at 500 volts though, but may go much higher. In fact, you can get an interesting purple arc across the tank capacitor with no loading! Same action at the other plate, but of course a ½ cycle later. Fig. 2 shows plainly the "turning fork" or resonance effect that takes place between each plate and that there is no bypass needed back to the cathode. There is of course a steady average potential difference of 500 volts between both plates and the cathode. Remember though that this only an average, or dc difference. At one moment, rf-wise, it may be zero, the next moment 1,000 volts difference.

So, enough on push-pull. It works. You can use coils of course instead of straps. I did in this unit on 50 mc, for convenience.

Time was, on 5 meters "long-line" plate tanks were quite the thing. You went to someone's shack and there up on the wall or stretched out on a table were some three feet or so of double copper tubing, side by side, as in Fig. 2. You can also wind up the copper strap into coils. I find myself using more and more C and less L in these 50 mc tanks. Some day I'll check to find out just how little L you can use. Sure cuts down on harmonics.

The Circuit and Tune-up

Fig. 3 shows the complete circuit. It is quite simple really and similar to class C amplifiers you find in the books. Except it doesn't need a modulator. While grid circuit "swamping resistors" are recommended for SSB linears, I could find no advantage here in the AM linear. Not only that, but remember that the Sixer does not have unlimited rf power output.

The 815 is mounted horizontally on a vertical wall of copper-clad bakelite. I'm sorry to be continually repeating about this material, but until someone shows me something better for experimental rigs, that's for me. Fig. 4 is a bird's eye view of the assembly. Fig. 5 is a front view of same, and Fig. 6 shows a pictorial of the 815 socket wiring.

Providing you use a good shield-wall to mount the socket on, and follow the simple neutralizing instructions, you can probably use a more compact assembly, or a different one, to suit your construction needs.

In Fig. 5 the grid and plate tuning capacitors are shown without mounts, I used the same bakelite again, soldered to the base plate, shown in Fig. 5, for mounting brackets. Of

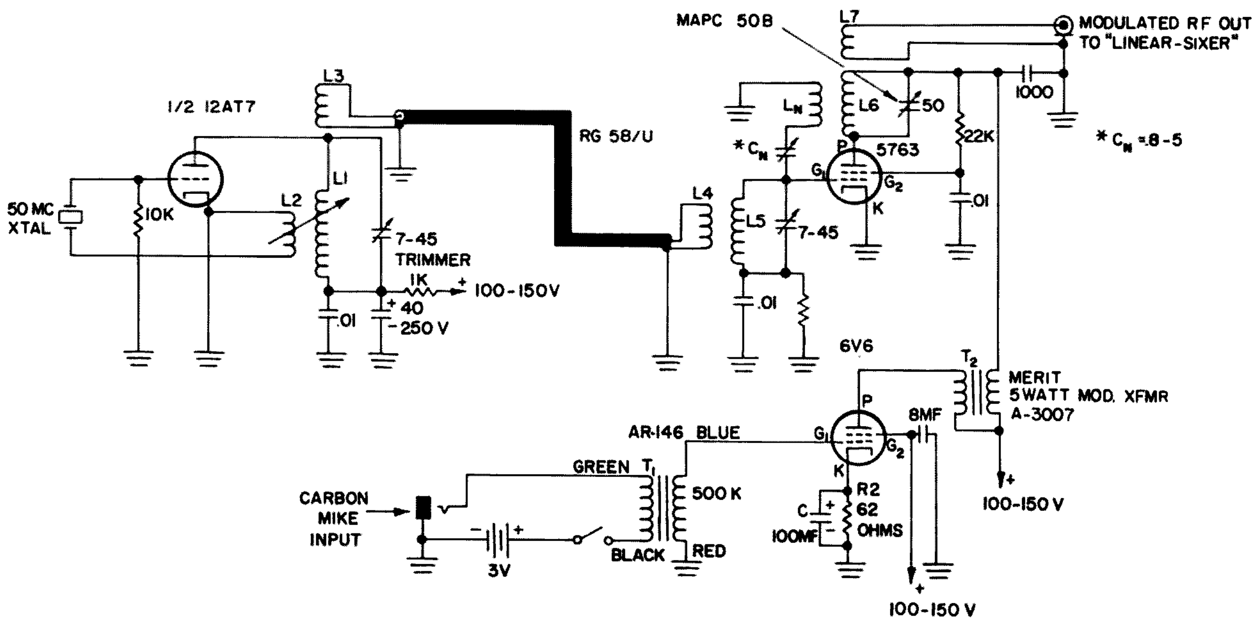


FIG. 7
Driver modulator for linear

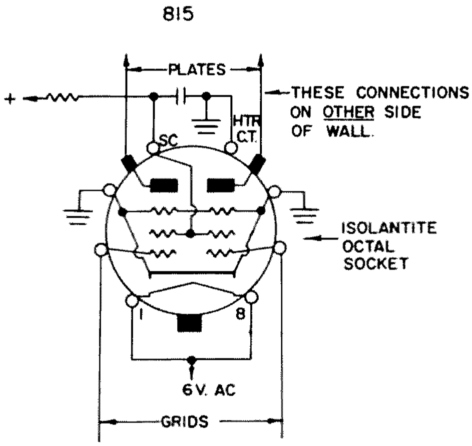


FIG. 6

course, if you want to use heavier non copper clad bakelite with metal angles, nuts, and bolts, go ahead. In any case, use insulated shaft extensions.

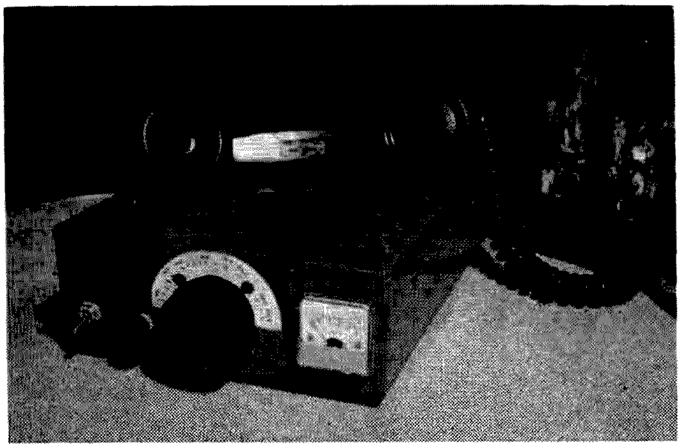
Incidently, in Fig. 5 I did something for which I could be thrown in the clink. I used ordinary capacitors instead of symmetrical butterfly ones! It still works, but be sure and use butterfly capacitors and you will get a better balance in the L2 and L3 circuits. Hammarlund BFC-50's are recommended.

Fig. 5 also shows the neutralizing circuit. This is important but not critical, so don't worry about it. It acts very clean and neat. With the complete set up as in Fig. 3, apply filament voltage but no screen or plate voltage. Then, with rf drive from the Sixer or other driver applied to J1, some 15 to 20 volts should develop across R1. A diode detector tuned to 6 meters should be plugged into J2. Do *not*, I repeat, *not*, turn on the plate and screen voltage of the 815 unless you own a *lot* of diodes!

Some rf should show in the detector, unless you just happened to have neutralized the 815 on wiring to the dimensions shown by good luck. Fig. 6 shows exactly 2½ inches of wire for the cross-over neutralizing "capacitors." The way I did it was to make them a little longer and then trim them down near the right length. Then, watching the diode meter for the neutralizing null, which will be very evident, trim the wires for that null. You can bend them a little, leaving the wire tip pressed against the tube glass for rigidity. Once done you can leave them years.

Further checks can be used, although of a less precise nature. First, tune the plate circuit through resonance, without plate or screen voltage, and watch for absence of reaction on the grid circuit. A voltmeter across R1 will show movement if the tube is not neutralized. The above is with rf drive from the exciter.

(Turn to page 92)



Henry Cross W1OOP
Robert Lothrop K1IWI

A Truly Portable Six Meter Station

The equipment which is to be described was built by K1IWI and is the revised and improved version of W1OOP's rig. The original idea was to make a better receiver which could be used in conjunction with the Springfield CD Walky-talkies, for net operation at sports-car hillclimbs, at spots not suitable for parking a car. When the receiver was finally done, there was so much room that we put in a transmitter also. With the right hill under you, it can be a lot of fun to use, and the battery life is long enough for a full day of operating.

The set consists of a crystal-controlled converter, a tunable *if* receiver covering 7 to 11 mc/s which is also handy for listening to CHU, a crystal-controlled transmitter taking 25 mc crystals, and a class-A modulator with clipping. There are 17 to 20 transistors, depending on whether you incorporate the optional final, BFO and squelch. The drain on receive is under 20 ma at 12 volts, and on transmit about 250 ma. With eight MN1500 penlite cells ($2.64 worth) you are set for a long day of hamming, or about 30 hours' net operation with a loudspeaker. Two F4BP lantern batteries ($1.58 total) will go about three times as long. The ten-cent penlight cells will poo out after a half dozen transmissions, so don't bother with them. K1IWI goes mountain-topping with a pair of hot-shots and claims they last forever.

The receiver, so far as we can tell, is good enough. There is some cross-modulation from strong local stations, but many "tube" receiving setups are as bad. The sensitivity is good, about 5 db noise figure including the losses in the protective circuit. The selectivity of the prototype was at one time adjusted to be 3 kc wide at 6 db down and 20 kc at 60 db, about the same as the early HRO's, but the coupling was later modified to make the receiver a little wider for net operation, by increasing the coupling capacitor between the pair of *if* coils to the value shown. It's still more selective than the older Gonsets.

Receiver drift is small, and what there is, is not caused by the transistors. Regulated voltage is used on the tunable (second) oscillator and its associated mixer to get away from battery voltage shift as the cells recover from a transmission. Transmitter drift is much less than found in tube transmitters using the same crystals, although the circuit was set up for maximum output.

The transmitter makes as much noise as can be expected from flea power. With a two-element portable beam Bob talked to five states from the top of Mt. Monadnock (the one you walk up) while W2NSD/1 was not using the ether. It is even fun to work W4's and W9's when you are about a watt—and hard, too. The point is that there are many spots where you can go with a lightweight portable and not find a bus-mounted kilowatt there ahead of you.

SOLDES

Si certains numéros de 73 vous manquent, voici une excellente occasion de complèter votre collection. Pour 5 F au lieu de 8, nous vous enverrons 4 numéros à votre choix (postérieurs à février 61). Si vous désirez recevoir une année complète nous vous enverrons toute la série pour 13 F alors que le prix normal est de 20 F. (A la rigueur nous accepterons 14 F au lieu de 13 si vous êtes superstitieux!)

Pour vous faciliter les choses, vous pouvez virer la somme dûe à F2 BO.

J-P CATALA, CCP 9372-41, Paris.

GELEGENHEIT

Falls Ihnen *einige Exemplare von* 73 *fehlen*, bieten *wir* Ihnen die Gelegenheit, diese Lücke auszufüllen. Für 4 DM statt 6, können Sie 4 Nummern Ihrer Wahl erhalten (ab Februar 1961). Ween Sie einen ganzen Jahrgang wünschen, können wir diesen für 10 DM anstelle 16 DM übersenden.

The antenna tends to be heavier than the transceiver. Hi-Par makes a portable beam (we don't have one) which should be fine. For walk-around use, like at hamfests, a center-loaded piano wire whip does the job. In any case, there is a problem setting up the transmitter, and you should have a sensitive tuned field strength meter with some provision for monitoring with headphones. Currents don't change much with tuning, but modulation quality is critically dependent on the tuning of the final. There is sidetone provided to the earpiece of the WE handset, but it only tells you that the modulator is working. Rf power transistors for use at 50 mc are a bit of a problem. Since both the driver and final have modulation applied, the required breakdown voltage is a little less than four times the battery voltage for each stage—say 48 volts for BV_{CER}. If BV_{CBO} is what the manufacturer specifies, it should be over 60, in our experience, i.e., type 2N1506 performed ok but 2N1505 and 2N2297 appeared to break down on modulation peaks, causing flat-topping. (A Tektronix 545A with suitable plug-in will allow you to view the rf envelope across a 50-ohm load, if you feed the audio in as an external trigger.) The high-frequency performance of types used for 27-mc CB rigs is seldom good enough, but it might be worth while to try a few dozen to find a good one. In general the ratings on rf transistors don't include AM, but a type rated at 1 watt out at 28 volts at 70 mc should be good for a quarter watt AM carrier output at 14 volts at 50 mc if you have enough drive (typically at least 110 mw.). When better transistors are made, you can expect that we'll try to use them at even higher frequencies (where as usual they won't work very well!)

The reason both final and penultimate stage are modulated is that with low gains and what is roughly class-B operation, modulating one stage doesn't seem to work. Also, neither the final nor the driver should be loaded for carrier conditions, but (like a Gonset linear) they should be tuned and loaded for best "upward" modulation. Since the transistor gain is much higher at, say, ten mc than at 50, there is a good chance of having parasitics at several mcs, though not much likelihood of trouble above the output frequency. A trick peculiar to transistors comes when the collector (in these NPN's) swings in a negative direction as the base goes positive to the point that current flows from base to collector, and for an instant in the rf cycle the output and input are connected. In one instance, this was

found to react back to cause the oscillator stage to stop, giving an extremely overmodulated-looking output (the modulation envelope pinched off completely) and an extraordinary amount of buckshot. FM comes much easier.

The transmitter schematic is shown in Fig. 1. Useful carrier power output is about 1.5 watt,* with fairly good audio quality. Someone compared the modulation to a Zeus, but we heard that his receiver is working better lately since he got it fixed. To transmit, plus 12.6 is applied to the complete transmitter by the send-receive switch or relay. A type 2N706 or similar is used in the 25-mc oscillator. The circuit tunes like a triode tube oscillator, that is, the tank should be a little bit on the high side of crystal frequency. With a few exceptions, CB oscillators will work fine in this position, but not all makes of 2N706 work well. Fairchild and PSI seem to be better for rf work than others.

The second stage doubles from 25 to 50 mc. The oscillator tuning may be checked by observing rectified base current across the 820 ohm resistor. A relatively high-c collector tank is used at 50 mc. Note that some transistors of a type may have higher than rated breakdown voltage, but don't bet on which ones.

The driver is pretty ordinary. Neutralization is not used; large-signal amplifiers cannot be neutralized exactly, because the base-to-collector capacitance is a function of the voltage between the two elements, i.e., it's a varactor. The modulation can be applied in either the positive or negative lead, since there is no heater or filament insulation problem, and we chose to put it in the negative lead in order to make it possible to use a center tapped choke in conjunction with a pnp power transistor. The rf chokes and ferrite beads specified are what we used; a small solenoid wound on a 47-ohm resistor would probably do as well as the beads, if the latter are not obtainable.

The modulator is designed for a carbon mike. To use a crystal mike (ceramic, if you will be in the hot sun) would take two more transistors. The first stage is NPN, since we are using negative ground, and its collector current flowing through a silicon diode provides bias for the other transistors. Two silicon diodes across a miniature choke (a transistor radio output transformer) clip the speech waveforms at about 1.3v peak-to-peak. An emitter follower using just about any PNP alloy transistor drives a power transistor operating class-A. If you cut the carrier when you have nothing to say, a class-A modulator amplifies square waves as efficiently as class-B. Any auto radio output transistor will work, although the 2N1172 (TO-37 style) miniature unit would be much smaller and about the same price. The unbypassed emitter resistor in that stage is adjusted to such a value that the current through the two halves of the choke is about the same. The center-tapped choke will be about half the size of the choke that would be needed for Heising modulation.

Construction—General

Bob built his transceiver in a commercial

* Bob's Heathkit "Sixer" read 1.0 watt on the same wattmeter.

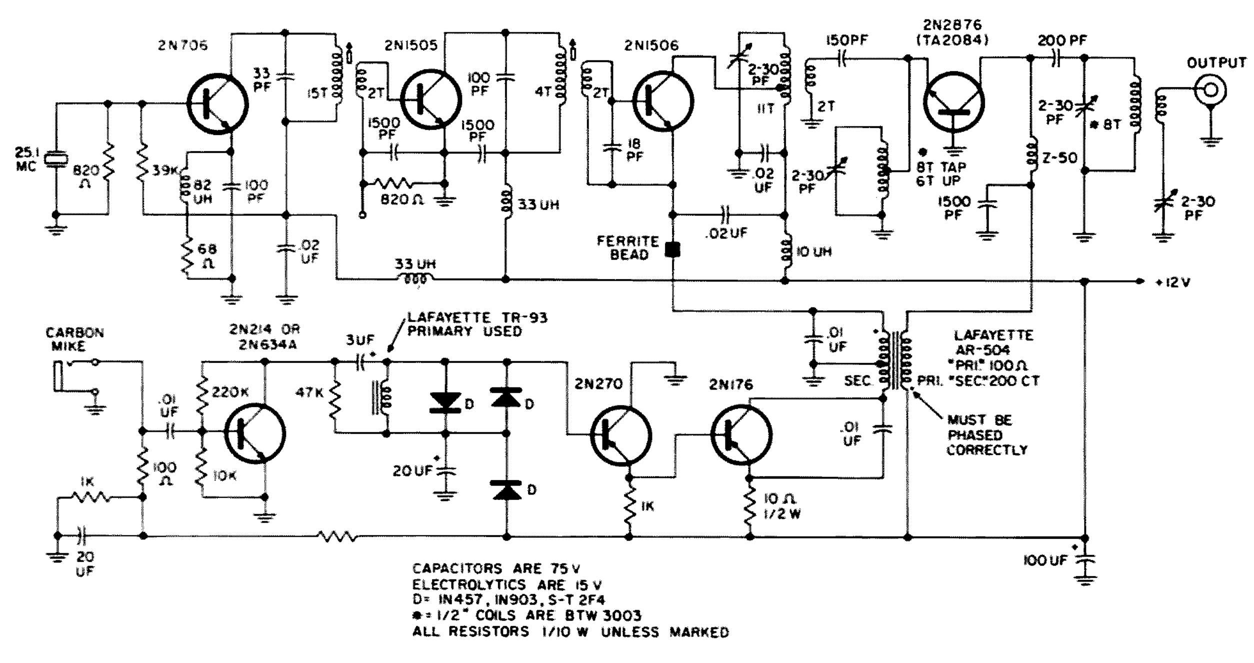
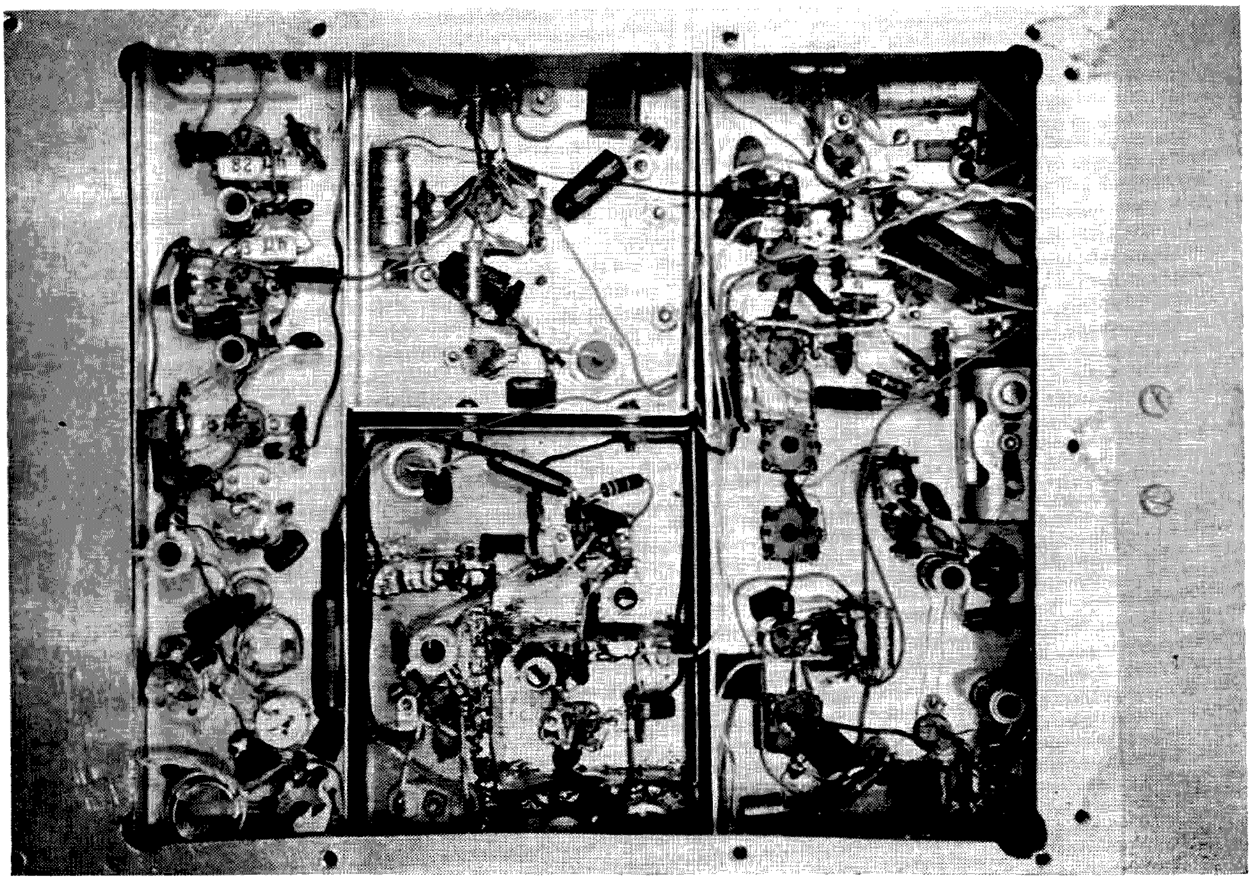


FIG. 1



Transmitter   Modulator   Receiver
Converter

8 × 12 × 3 aluminum chassis. The smallest face becomes the front panel. Four chassis were built up to fit the available space, with the receiver full width next the panel, then two half width units for the modulator and the converter, and finally the rf section in a chassis about an inch and a half by eight. Batteries went in the rear, but the photos show the fourth stage on the transmitter, with external batteries being used.

As the photos show, the open side of the chassis was fitted with a cover plate, while the other face was mostly hacked away to allow access to the other side of the subassemblies without removing them.

The main mechanical problem is to get adequate tuning precision and mechanical stability in the receiver; it should be fitted so as to make sure the dial and tuning capacitor line up right, which is best done by first mounting the dial, then connecting the T C, and then spotting where the tuning capacitor mounts on the chassis. Send-receive switching is done with a wafer switch. Only two poles are really needed, as the audio amplifiers are separate.

Heat and heat-sinks. The silicon transistors in the rf section will work satisfactorily without any heat radiator, although they get hot. Thermalloy #2211 heat sinks (in Lafayette's catalog) help quite a bit, and it wouldn't hurt to put the same type on the audio output transistors, if TO-5 size are used. The modulator power transistor is mounted on the aluminum chassis with the mica insulator supplied (at least it is with Delco types) for electrical insulation. Check for and remove all burrs in the area covered by the mica. Run your tongue over it to check for smoothness.

Components. The individual units were made up on .040 aluminum chassis to simplify grounding and shielding problems, except the converter, which was made of 0.031 brass, so that shields could be soldered in place. Sockets were used for the transistors, a great convenience when there is a desire to try various types. We used saddle mount sockets (Elco 05-3301) with four pins which would accept TO-5 transistors directly, as well as TO-40, 2N43, 2N78, 2N270 and TO-11. Other types such as TO-7, which has a shield lead, TO-44 which has leads close together, TO-1, TO-18 and such can be plugged in by arranging the leads properly. The sockets were mounted with 2-56 brass hardware. Solder lugs for no. 2 were made by using the small

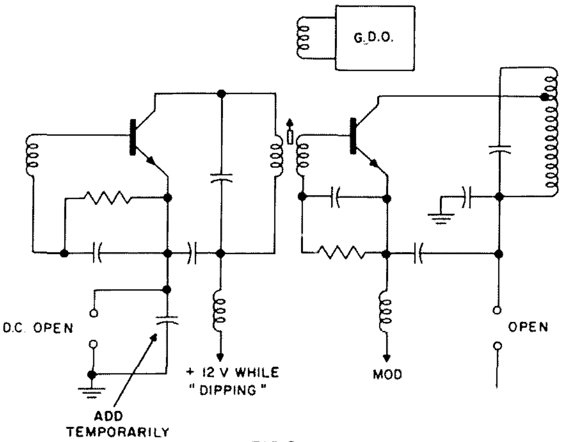


FIG.2

To tune up a transistor interstage with a grid dipper, you apply collector voltage to the previous stage, make sure the base return (coil or whatever) is in place, and disconnect the emitter lead. The driven stage should have collector voltage disconnected. Now you have 12 volts or so between collector and base of the previous stage, so the C-B capacitance is approximately what it will be when things are going, and the next stage has zero bias. Couple loosely to get a sharp dip; if the GDO signal is more than a few hundredths of a volt current will be drawn and the capacitance will be changed. A transmitter interstage set up to dip is shown here.

end from standard size solder lugs. Model railroad hobby shops have the small bolts and nuts.

Resistors. We used several styles. Our advice is to use ohmite (Allen-Bradley) QUARTER watt types. The half watt use too much space, the tenth watt type are impossible to wire without tweezers and a jeweller's loupe —and the color code is hard to see—but the quarter watt size is just fine. Lafayette had some Japanese desposited-carbon resistors which were very fragile, and the small Globar resistors came apart when the soldering iron got them too hot. An Ungar pencil iron on a Variac worked well, but the smallest GE iron with a resistor in series (cut out by a foot switch) was even more convenient.

Capacitors. The electrolytics were C-D type NLW (easy on the leads, some broke off first bend) or assorted Japanese. The coupling and AGC electrolytics might be Mallory TAM or similar, though the aluminum type is satisfactory. The rf and *if* bypasses were mostly 75-working-volt ceramic types from Lafayette, with some 10-w.v. ceramics used as base-return-to-emitter bypasses where there normally is no more than two volts. You've never heard a noisy component until you put 12 volts on a 10-volt ceramic capacitor. Like frying bacon.

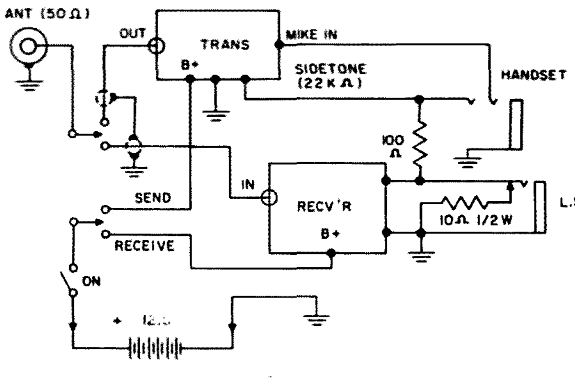


FIG. 3

Battery mounting. If internal penlite-sized batteries are to be used, they may be mounted in commercially available clips which hold a group of two to four cells, bolted to a wall of the case. We have had trouble with these after rough handling (the transceiver is just the right size to drop!) from the batteries getting askew and not making good contact. It is suggested that the batteries should be accessible for voltage check under load or physical inspection *without a screwdriver.* A piece of insulating material held in place over the clips would also prevent cells coming loose. With the F4BP lantern batteries there should be no problem, since it is easy to keep the binding posts tight. Certain types of closed-circuit type plugs or the equivalent could be used to hook into an external power source. The MN1500s appear to take several partial "recharges," so maybe it would help to plug into the car battery with the internal cells still connected: a blocking diode (1N91) is suggested to avoid trouble from reversed polarities or low external voltage.

Converter. (Fig. 5.) The 50 to 7 mc converter was originally adapted from a QST article. Like most such, there were enough changes that there is no justice in involving the original author. The main thing is to remember that there is no substitute for a good transistor in the first stage. The rf amplifier is used grounded-base, for reasons now only a dim memory. A silicon computer diode (not just any type, check the numbers) is used as a limiter at the input in hopes that strong 50-mc signals will not immediately melt the first transistor. Transmitter leakage is not bad, but what if the transceiver with whip attached is carried by a mobile just when he goes on transmit? A good check on the diode is that it should make no difference on weak sigs, on or off.

The double-tuned coupling helps keep Radio Moscow off six meters, but if some oscillator juice should get back to the rf input, there is still a chance of interference. We used 0.010 copper (sheet? foil?) for shields. The oscillator circuit is a legacy from the QST article. The circuit shown in the transmitter, adapted for PNP, should work as well. The main thing is that the oscillator should start reliably and not move around with voltage changes. Required drive to the mixer is a couple of milliwatts. Mixer injection is somewhat fussy. Because of the fancy bias network, mixer current will only change a few per cent with the proper amount of injection. If in doubt, use less, so as to reduce the birdies and the spurious responses.

Roughly speaking, the 50-mc input impedance is the same grounded-emitter or grounded-base, about 30 ohms at the usual currents. The rf stage might as well be a premium type (still under three dollars) and the rest can be any type recommended for TV or FM use. See the section on the transmitter for tips on grid-dipping. The mixer plate lead feeds a pi-section low pass filter which is intended to reduce the quantity of 43 mc signal delivered to the 7-11 receiver. If this is very strong, it will combine with harmonics of the second oscillator in the second mixer to give birdies (in pairs) each time the 2LO harmonic gets 455 kc away from the 1LO frequency. The pi-section interstages are also intended to reduce the transmission of 43 mc. Tapped-coil coupling, used in the prototype, was quite bad in this respect, as the taps seemed to resonate in the 40-50 mc region.

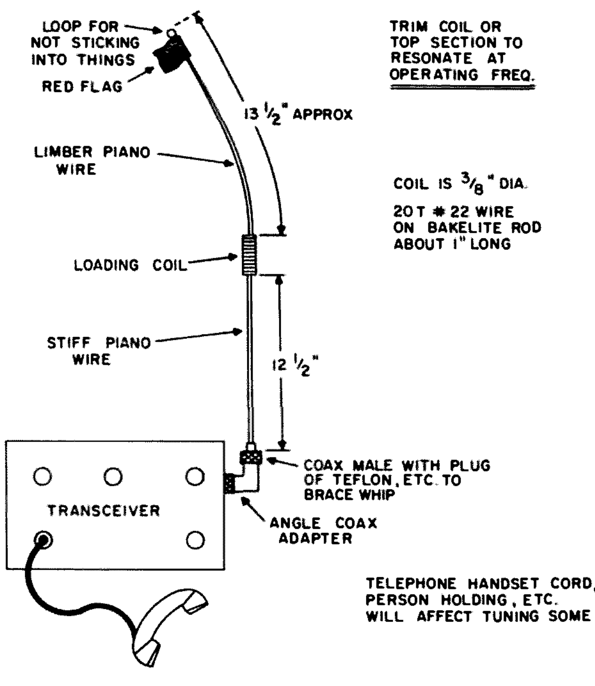
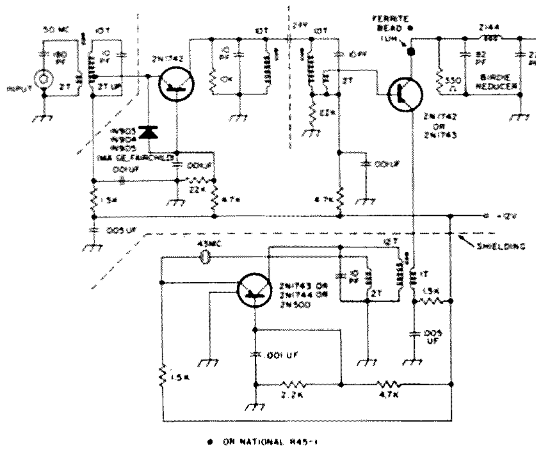


FIG. 4



* OR NATIONAL R45-1

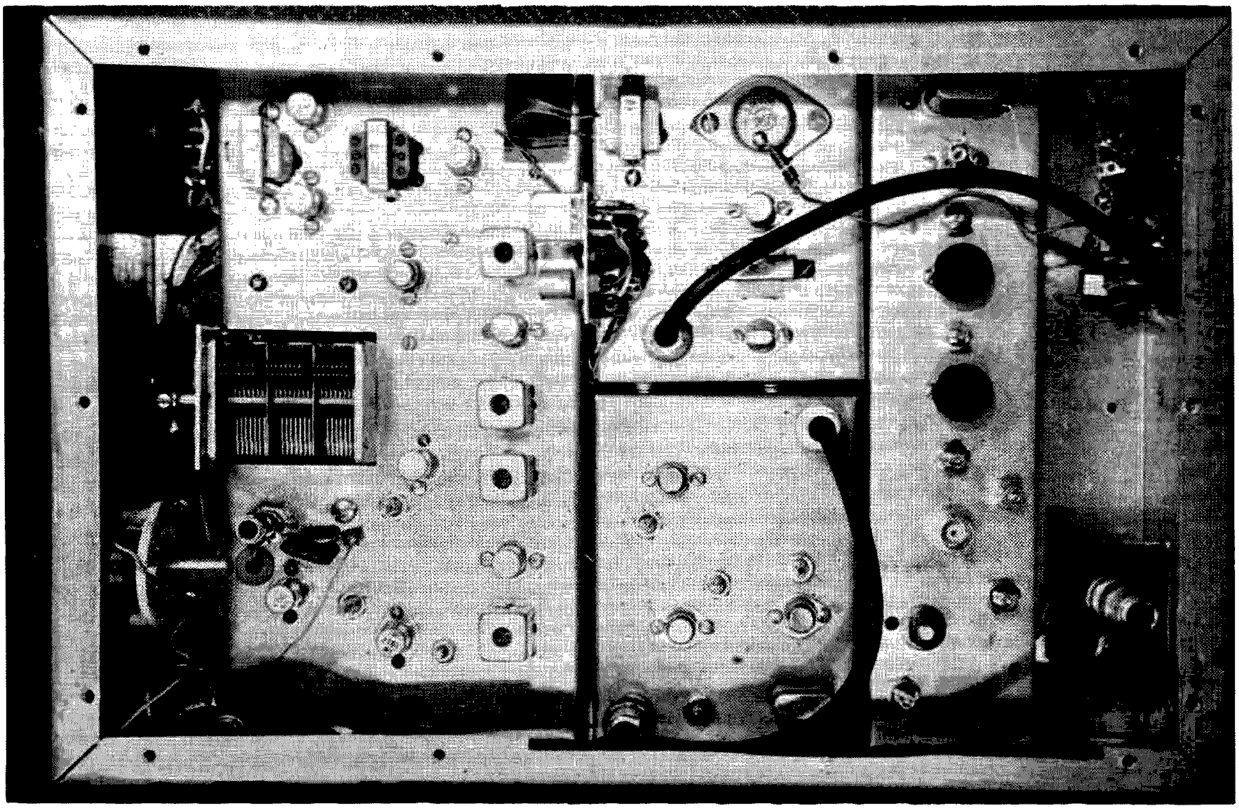
FIG. 5

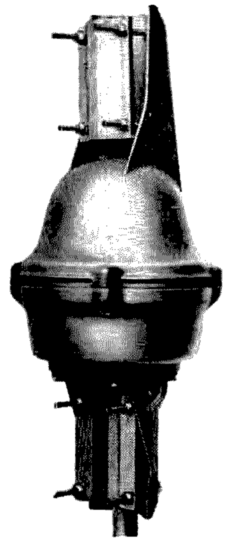
All resistors ¼ watt, all capacitors mmfd, all coils on ¼" ceramic tuned forms.

The converter and receiver amplifier stages are unneutralized. Per-stage gains are fairly low by design, and the MADT, PADT and "drift" transistors used have very low collector-to-base capacitance. They are cheap enough that there's no point in substituting.

The 7-11 mc "tunable *if*" is a complete receiver in itself. (Fig. 6.) Rf gain is fairly low to reduce overload in the broad-tuning stages, but there should be no difficulty in getting all that's needed in the 455 kc amplifier. There is a tuned rf stage, a mixer and separate oscillator, two stages of *if* at 455 kc, a diode second detector, a separate agc rectifier, and two stages of audio. Optionally, there is squelch and a BFO, with provision for manual gain control. Audio output power is enough for mobile use. Most of the parts can be found in the Lafayette catalog, or salvaged from defunct transistor radios. The tuning capacitor used was 365 mmf per section and had nearly semicircular plates, so that with the series capacitors shown, the low end of six is spread a lot, but the high end is still covered. Try and get a sturdy one, and mount it so that straining the case won't twist the capacitor frame.

If you have never built and tracked a superhet before, this is one heck of a time to start. The main idea is that two gangs of the variable capacitor tune circuits from 7 to 11 mc/s, while the third, in this case, tunes an oscillator from 6545 to 10545 kc, 455 below the signal frequency. The trimmers built into the tuning condenser (if there are none, wire some 3-30's in) are used to make things come out on the high end, and the slugs in the CTC coils are used to put the coils on the right frequency at the low end of the range. Since the slugs move things by the same percentage at each end and the trimmers have about twice the effect at the high end as at the low end, trimming at each end alternately several times is likely to converge to the proper condition, where the circuits track all the way. It is very convenient to





have some sort of signal generator or test oscillator on hand when doing this, but a grid dipper can be used as a makeshift substitute. The 220, 470 and 720 pf capacitors which are in series with the coils and tuning capacitors should be silver mica type, and within about 5 per cent of the right value. Do *not* use "BC" or "GP" type ceramics—in fact any ceramic capacitor that seems small enough to use is probably not good enough to bother with. Arco CM15's or DM15's come small and with excellent electrical characteristics.

In this receiver, AGC is applied only to the 7 mc rf stage and the first *if* amplifier. AGC on the 50-mc rf stage might help, but was not included. It is not desirable to cut

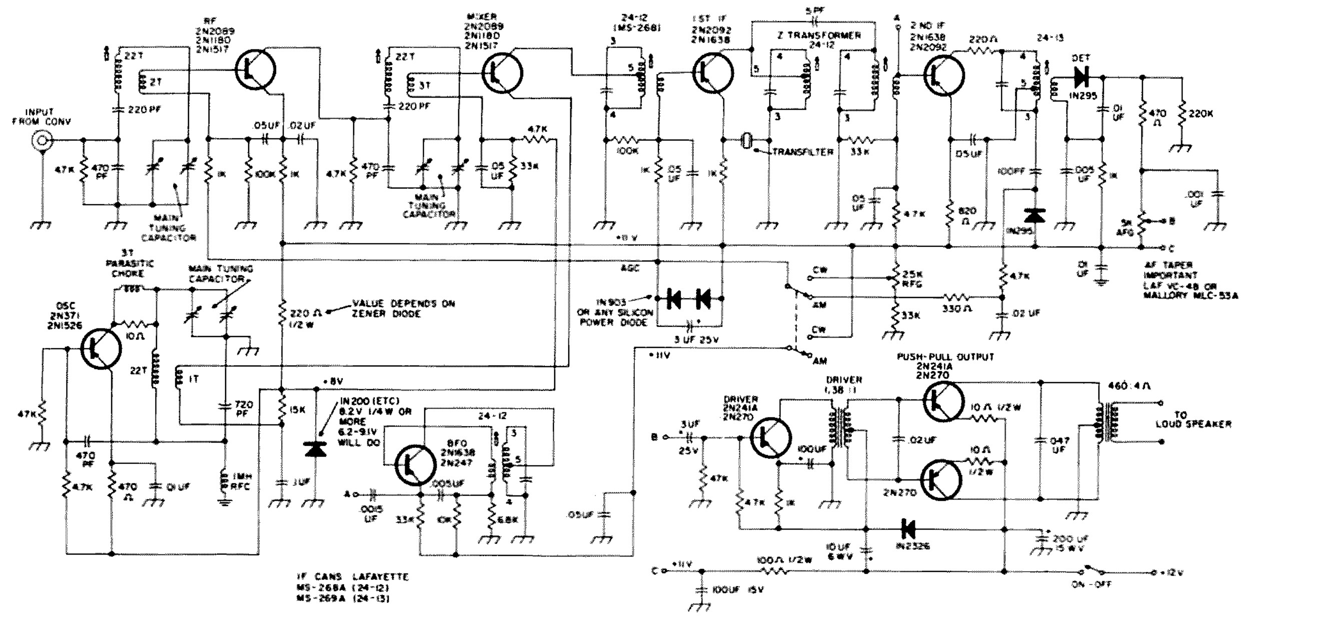


FIG. 6

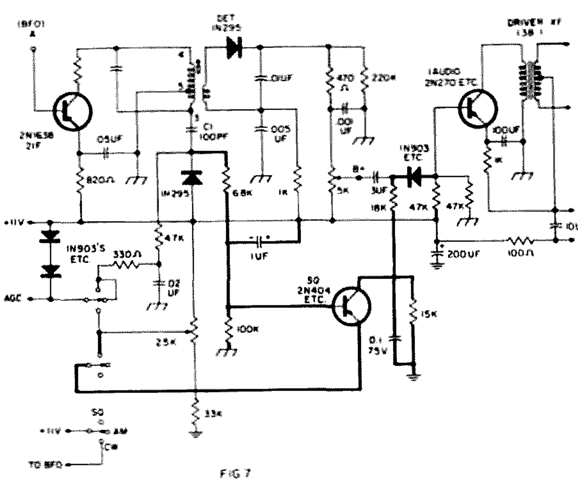


FIG 7

C1 may be changed to 150 or 200 mmfd if strong locals still overload or block on AM.
Changes shown in heavy lines.
* RF gain in CW pos.—sq. in sq. pos.

the gain or collector current of the second *if*, as all the power it can deliver is sometimes needed. In order to get good AGC action with transistors, the last *if* amplifier must deliver enough power to the AGC rectifier to allow it to develop sufficient voltage to buck out the forward bias normally applied to the base circuits of the various rf and *if* amplifiers. For a 50 K ohm bias divider the required current is 12.6/50,000 or about 250 microamps. 250 ua through 5,000 ohms (4,700 plus 330) is 1.25 volts. The power needed is thus about 1/3 milliwatt under carrier conditions or 1.25 mw peak. If the last *if* stage is running 1 ma of collector current at about 11 volts, there is a maximum of 5 mw rf power output available class A into a 10K load. If one fourth of the theoretical maximum is needed to develop the DC for AGC use (assuming a perfectly efficient rectifier, which is not likely at one volt out) things are pretty thin, and we cannot afford to cut the collector current of the second *if* stage at all. If the taps on the last transformer are wrong, no signal, no matter how strong, will develop cutoff bias, and the receiver will wipe the modulation off strong local signals. If there is some doubt, feed the BFO into the last *if* input full strength and see if the emitter current of the first *if* (as measured by the voltage drop across the 1K resistor) can be forced to zero and beyond. The "beyond" is to allow for modulation peaks.

The control voltage in the absence of a signal is clamped by a couple of silicon diodes to about 1.1 volts forward bias. When the AGC starts working, the diodes unclamp, but the *if* voltage at the AGC rectifier has to be about a half volt before this takes place, that is, the AGC is "delayed." Any good silicon junction diode—power, top hat, alloy, diffused, or planar—will work here as the AGC clamp. The types suggested are small. The detector and AGC rectifiers are 1N295, similar to 1N34 but small and tested as a dectector.

When a squelch is used, it is desirable to set tihngs so the squelch opens before the AGC starts to work. When the BFO is turned on, the AGC must be disabled, and to do this we shift the line to a manual gain pot. The clamps still function to limit the maximum-gain forward bias to a safe value.

The oscillator circuit is a modified Colpitts. It is not as easy to get going as a vacuum tube oscillator because there is not any amplitude-controlling mechanism in a transistor oscillator equal to the grid-leak-and-condenser we are used to in tubes. Because the oscillator is around 7 mc, and a good oscillator transistor should be suitable for much higher frequency (so that the transit time, which varies with voltage and current and temperature, will be small compared with ninety degrees at operating frequency) there is danger of parasitics at higher frequencies, so a parasitic choke was put in.

As in the first mixer, the amount of drive is critical, and a bit of fiddling with the one-turn pickup coil (move it along the form to vary injection) will be needed. The oscillator runs on the low side with the values shown.

The *if* amplifier as drawn has effectively five tuned circuits. The Clevite TF-01A resonant emitter bypass has about as much rejection of off-frequency signals as another transformer. If you can't get one, use an 0.1 mf capacitor in place of it. The *if* transformers are small ferrite-core jobs, apparently U.S. made, which have an unloaded "Q" of about 140 at 455 kc. As the drift transistors have higher output impedance than the alloy types which were common when these were designed, we have our choice of more gain (by tapping the collectors up) or more selectivity (by using the former collector tap).

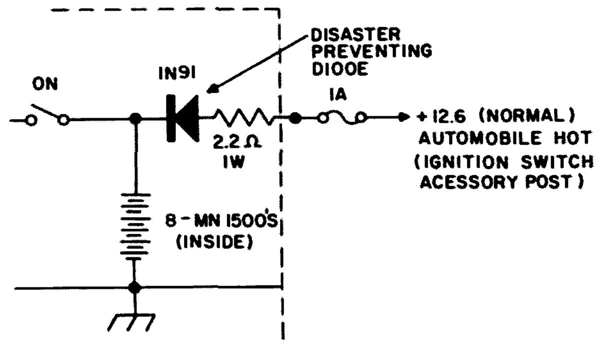


FIG. 8

We went for selectivity, except in the last transformer, which is heavily loaded by the diodes. Most 455 kc transistor *if* cans found in small six-transistor radios can be used in place of those specified; the connections are fairly standard. If more selectivity is needed, two coils coupled by a capacitor could also be used between the mixer and first *if*, with only a small reduction in overall gain. The coupling capacitor between the paired coils is run to the tap, so that a larger, easier to control capacitance can be used.

To align the *if* amplifier, a signal may be "stolen" from another receiver, by wrapping a wire around the last *if* plate lead in your HQ 129 or whatever, and tacking it to the base lead of the mixer in the transistor receiver. Tune the HQ 129 to a nice strong broadcast station and start twiddling screws. The single-tuned coils are just peaked for maximum output measured with a Simpson, etc. across the audio gain control (about one volt at most) and the double-tuned pair is adjusted by clipping about 100 mmf across the primary terminals of one can and trimming up the other, then moving the 100 mmf to the primary terminals of the other can and peaking the first.

The audio amplifier is conventional. It differs from most small transistor radio audio amps in that it runs on 12 volts and puts out half a watt rather than 9 volts and a quarter watt. The idling current of the class-B amplifier should be about 2 ma. Less gives scratchy quality, more uses too much electricity. The diode gives a no-signal bias which varies with temperature in the right way to compensate for the thermal characteristics of the output transistors. If a IN2326 is not available any cheap alloy PNP transistor may be used, connecting to the base as cathode and hooking collector to emitter for anode. A small adjustment in the idling current can be made by changing the value of the emitter resistor in the first audio stage.

The BFO circuit shown will work with almost any alloy transistor, but the loading on the signal circuits will be a little less with the drift unit specified. Any interstage *if* transformer will work. The BFO is tuned to band center. No pitch control is provided.

If squelch is desired, it is inserted as shown in Fig. 7. The manual rf gain pot is used to set the squelch level, when that function is in use.

In the first model, one transistor was switched between BFO and squelch. The BFO was too near the front end of the receiver, and BFO harmonics were all over the dial. Segregating the BFO fixed this: in the photos the BFO assembly is tacked on above chassis. In the receiver shown in the photos, a transistor is in the squelch socket, but the socket is not wired.

A list of possible transistor types for the receiver is given in Table 2. The recommended types cost from fifty cents each for some audio types to about a dollar each for the 7-11 rf and two and a half for the hot six-meter rf stage. You may find something satisfactory in your pickle jars full of slightly surplus semiconductors, but it's not too likelv. The types used in Japanese AM (not AM-FM) radios will not be suitable. Required collector breakdown voltage is at least 20, and 30 is better.

. . . WIOOP

Table of Transmitter Transistor Types

A. Silicon NPN RF Power transistors

Oscillator: Some 2N697, 706, 707, 708 some 2N718, 753, 759, 760, 913, 914, 915, 916, 957, 2N834, 2N1338, 1505, 1506, 2297.

Doubler: 2N707, 708, 915, 1505, 1491, 2297. If modulated, may have voltage breakdown problems. 2N1506, 2N1492, 2N1493, 2N1342, 2N2218, 2N3118 should be O.K. modulated.

250-miliwatt final: 2N1506, 2N2876, 2N2631, PT531, TA2084, 2N1978, 2N3118. Nothing more than five years old.

1.5-watt final: 2N2876, TA2084, PT657.

NPN AF amplifier: 2N35, 78, 167, 169, 214, 388, 445, 634, 635 etc.

PNP AF driver: 2N43, 188, 241, 270, 396, 404, 407 and many more.

Modulator: 2N1172, 2826, 2827, 2N301, 176, 276, 342, 553, 554.

Table of Receiver Transistor Types

Converter-RF 2N1742, 2N2494, 2495, PADT-28, 2N502A, RCA 2N2873, Philco T 1694, 2N1177 (last choice)

Mixer 2N1743, 2089, 1177, 1179, 2N1745, 2N1517

Osc. 2N1744, 1743, 1178, 2084, 1517, 1745, 1868, 2N501

7-11 RF 2N2089, 1180, 1517, 2084, 2N384, 370, 2N1726, 1747

mixer 2N2089, 1180, 1517, 2084, 2N372, 2N274, 2N247

oscillator 2N371, 1526, others will work, may need changes in feedback.

IFs, 2N1638, 2N2092, any listed above, for RF or mixer

BFO almost any computer or drift transistor, 2N1631, 1637, 247, 274. Squelch-anything.

AF driver & af output 2N270, 241A, 188A 525, 2N43A 2N1413, 2N1924, 2N1192

Zener diode = 1N200, or any up to 1½ watts, 6.8 to 8.2 volts nominal.

Note on transmitter transistors: The types used are Silicon NPN. If suitable transistors are not available on a beg, borrow, or buy surplus basis, it may be advisable to consider using the Amperex 2N2786 PNP germanium unit, announced some time after these transmitters were built. (Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y. has report #S113 on how to use it.) The main disadvantage is that the 2786s we have tested had roughly 30 volt collector breakdown, so that AM at 12 supply volts is not practical. The proper solution is to use series modulation from a 12v supply, or NFM, or a collector supply dropping resistor, adjustable so as to set up for maximum collector voltage that the transistor will stand and still modulate properly. The Amperex report suggests that 2N2207's can be used in the driver stages. The driver transistor costs under two dollars, the 2N2786 under five. Carrier output level for AM would be about 140Mw. For NFM, about half a watt out could be obtained.

Now that you ask me . . .

Ken Cole W7ID'
P.O. Box 3
Vashon, Wash.

The readers of a certain magazine, which I won't identify further—except to point out that it receives mail at a New Hampshire post office—found in their August '63 issue a thought-provoking ballot. Some of the thoughts provoked might surprise the editor. Polling of readers by editors is commonplace, and often enough the readers are pleased by the implication of interest and indulge the editor in return. But the question should deal with the issue simply and specifically, and in the cited case I think the phrasing was oversimplified and unspecific. How can anyone be in favor of, or against, restricted phone bands unless he knows the conditions—what, why, where, when, and most of all—who?

This was annoying to me because Wayne Green's dedication and energy are invaluable to us, and I think the ham community is in trouble. I would like to see more polling of opinion by 73 on current and future problems, but only following upon a lively discussion of each issue, and then by ballots spelling out the saner proposals and free of ambiguity. The fact that the editor of 73 projects his personality rather eloquently may leave some readers thinking he isn't vitally interested in reflecting our opinions. He is. But he can't read your mind. This is our opportunity; let's have more views and then more ballots. In this prickly mood I hope to use up some space in 73 to disagree with the editor on one item, agree on another and invite comment (!) on a third.

Perhaps we can dissipate some of the heat arguing terms and save the light to illuminate the issues. Labels should be exact or they become worse than useless. In our own time heedless loyalty to reckless orators has led whole nations to disaster, so while we have an open forum for the exchange of opinion we had better use it. It's good practice, and a reminder that our favorite form of government is based on responsible debate.

Apparently the bad word in "Incentive Licensing" is incentive but the reasoning behind this escapes me. Incentives keep us alive. Our years are spent working toward goals of one sort or another—beginning, I suppose, with food, and ending with our individual definitions of a state of grace. Success is an occasional thing and inconclusive; "pursuit of happiness" was astute phrasing—the striving is life itself. Incentives are here to stay, I hope.

If the restricting of certain privileges (sideband and portions of twenty are speculations I hear most often) to a specific grade of license is the point of controversy, I'm for it. And if anyone loses ground in the shuffle he can catch up at his own convenience, if he's interested, by earning the grade carrying the authorization he wants. Our licenses confer privileges, not franchises, and in the light of what has happened on the electronic scene in the last few years a reappraisal of our qualifications may be in order. If you doubt it, listen to the bickering on 75 and the clang of swords on 20. Check stabilities and bandwidths, and reflect on the proliferation of phasing, filtering, VOX, elastic linears, compacted kilowatts and the five-dollar-down boom.

We worked for our ham tickets for many reasons. My original incentive derived simply from the concept of instant communication with unseen strangers. The mystique of private access to an invisible world was irresistible, but had it been free for the asking I doubt that hamming would have long competed successfully with the many interests that fascinate and plague most adolescents, for learning the code was tedious and theory a big, black hole. The self-discipline requisite to serious studying was new to me, but what I had failed to learn about it in high school came in the effort of getting that first ham ticket. It was a good lesson.

A-3 on 75 and the challenge of moving up a step provided the next incentive. Evolving curiosity and the acquisition of new privileges led automatically to a wider technical horizon and renewed effort. It would seem that, so long as a subject holds one's interest, this simple escalation by response to incentive describes an ideal educative situation. The goals are clearly defined and progress is timed to the applicant's own schedule. In my own case, and I inflict this recital on you because I've heard too many operators moan that some licenses are beyond their ability, Amateur Extra, First Phone and First Telegraph were difficult to get for I have had no technical training; at the sound of the word "mathematics" my brain squeaks in fright and skitters out of sight, and finally, I learn very slowly. Not slowly for a turtle, but very slowly for a human being. If the system worked for me it will work for anyone, and here and now I dedicate retroactively to Incentive Licensing—administered under various governmental auspices—my aeronautical, marine, marriage and radio privileges and I'll throw in for good measure the prerequisites of a hatful of Bar Pilot Licenses granted with contrasting carelessness by seaport saloonkeepers. Reflecting now on the hours of study these certificates represent I'm surprised that I'm still not smart. But I'm happy—and that's what counts in a democracy. What we need is more incentives.

To avoid being accused of claim-jumping by another magazine, I have refrained from referring to Incentive Licensing as "The American Way"; however, the subject of other magazines having now been rather lamely introduced I would like to drop a curtsy to a third publication, QST, and file a wordy little disclaimer here to the effect that my touting of Incentive Licensing does not imply support of ARRL policy on the issue and I'm sure they couldn't care less. I may labor the point but I beg indulgence on the grounds that nonconformists are jealous of their isolation and picky about circumstantial alignments. Incidental to the subject of alignment, I was surprised to learn from five local hams questioned that one smokes filter-tips, three smoke cigarettes, four use a popular pain-killer—blended not buffered—and all five are ex-members of the ARRL. Their reasons for separation vary from my own in detail, but agree on the simple proposition that the League is not representative of our interest in amateur radio. After determining that their independent positions were not products of the ARRL stand on any one matter, and provoking some suspicion of the motives behind my curiosity, I pedalled away with studied nonchalance.

Certainly the League does speak for many thousands of hams; the ARRL is indeed large, reputable and impressive, and it has my respect—but I claim the right to differ with it. And this brings me to "The Amateur's Code," a canon prominently displayed in "The Radio Amateur's Handbook." Item one includes the dictum: "He abides by the pledges given by the ARRL in his behalf to the public and the Government." Item two: "He owes his amateur radio to the American Radio Relay League, and he offers it his unswerving loyalty." After mulling this over enough times I realized that as an occasional dissident I did not fit the mold, and I had better reserve my all out pledge-abiding, debt attesting and unswerving loyal-

ty to other entities—such as my wife, and Uncle Whiskers, both of whom have in the past found occasion to exact fealty on equally sweeping terms, but for somewhat more vital reasons.

The more I thought about it the more it seemed that an incorporated group which refers to itself with some justice as "powerful and prosperous," and works to influence legislation in Washington, and treaties in Geneva, should advertise its assumption of mandate less grandly, and consider a code more responsive to the ferment of opinion in its membership. Monolithic qualities in an organization indicate rigidity, not vitality; and not an enduring firmness, but a hardening of corporate arteries.

On one subject, thank goodness, I find myself in complete agreement with Wayne Green —licensing fees. I even go along with his reasoning and that should take care of the subject, except that as a prospective fee-payer I naturally want to make stupid suggestions about how my money should be used. To clear the air (inside joke) and give everyone really interested a fair shake I think the FCC should re-examine every licensee in return for the first renewal fee. And subsequently an examination with every other renewal shouldn't be too painful a test of an amateur's interest in the art. Electronic progress has been wild, and a decade is a long time in our field and our age. Re-examination would mean to me getting out the lead and the books, or getting off the air, and it might turn out to be all three, but it would keep dilettantes from exploiting an international medium already suffering from its own population explosion, and the incentive and privileges would still be there for everyone whose interest is serious. The art would gain proportionately and it would be a pleasure again to listen to the ham bands.

Incentive Licensing is logical; re-examination would make reasonable frequency and emission restrictions fair and invigorate the community, and last but not least, "grandfather clauses" are pious abominations. If you have any interest in these matters, and I presume you do, I hope you will write, for or against, to 73 and the FCC.

. . . W7IDF

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More Notes on the 6DQ5

One of the more popular 100-watt-output final amplifier tubes around these days is the 6DQ5; this happy little horizontal-output bottle operates at approximately the same ratings as a 6146, but delivers nearly half again more RF output.

And with such a bonus built in, quite a few designers of commercial gear have also latched onto the Dog Queen Five as a natural. The Swan transceiver is one notable example of this.

However, it has recently come to our attention that the Dog Queen Five has another characteristic not shared by other tube types—and this one is bad rather than good. A 6146 is a 6146, regardless of who made it; the same is not true of a 6DQ5.

The tube manuals bring this out clearly, but we hesitated to believe it since the whole idea of tube type numbering is to ensure that all tubes with the same type number are electrically interchangeable.

All 6DQ5's have the same base wiring, and *approximately* the same ratings in TV service; however, the similarity ends there.

Before we get specific and start naming names, let us hasten to point out that no slight is intended toward the manufacturers involved. Our purpose is rather to avoid possible complaints from unhappy 6DQ5 users. After all, the manufacturers still don't rate this tube for RF service, so it's quite possible none of them have become aware of the differences yet!

Now, if you have a copy available, turn to page 199 of RCA Receiving Tube Manual RC-19 and take a look at the set of curves numbered "92CM-9311T." These are for the 6DQ5 at zero grid bias, with screen voltage varied. What we're looking at is the position of the "knee" or sharp change in direction of the curve.

With 100 volts on the screen, the knee occurs at about 35 volts on the plate, and 260 ma of plate current. With screen voltage upped to 125, the knee moves to 45 volts and 520 ma; with screen at 150, the knee is at 50 volts and 700 ma.

Now get a copy of the detailed G-E speci-

fication sheet on the 6DQ5; the one we're using is dated November, 1962, and the set of curves is numbered "K-55611-TD181-2."

Check the knee points. With 100 volts on the screen, the knee is at 60 volts and 410 ma. At 125 volts, the knee moves to 70 volts and 550 ma. And at 150 volts on the screen, the knee is at 75 volts, 720 ma.

It doesn't take an Einstein to figure out that the G-E version of the tube has a knee voltage about half again higher than that of the RCA variety. The higher knee voltage, in turn, means reduced power output is available even though the G-E tube does draw more current at the knee. The RF power available at the plate is equal to the plate voltage *swing* (from B + voltage down to the knee point) times the average plate current (knee value divided by four) times a constant 0.862 which allows for conversion from peak pulse values to RMS power out.

Thus with 600 volts on the plate and 150 on the screen, the RCA 6DQ5 would deliver about 83 watts of power output while drawing 175 ma. The G-E version would deliver only 81 watts while drawing 180 ma.

This doesn't sound like much difference, but plate-dissipation ratings enter at this point to limit the maximum power input to the tube with lower efficiency, thus extending the difference.

In practice, W5PPE reports a power output drop of about 15 to 20 percent when replacing the RCA version with the G-E type. This was in a Swan.

And before too many feelings are hurt at G-E, we must hasten to add that Sylvania and Tung-Sol also make 6DQ5's to this same specification. It appears, then, that the RCA 6DQ5 can only be replaced by another from RCA.

But we wouldn't want to make that a flat statement, since we haven't examined all the Dog Queen Fives on the market.

The physical differences between the "low-knee" and "high-knee" versions of the tube are easily distinguished. The photo shows one of each type side by side for comparison. The low-knee version, at left, is about ¼-inch taller, has the getter at the top of the tube, and carries three perforations in each side of the anode structure.

The high-knee version, at right, has the getter at the side, and the anode structure is solid.

In audio and TV service, both perform equally well and are as interchangeable as you would expect. But at RF, watch out. The power you lose will be your own.

. . . K5JKX

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The SJS Receiver

Part 1

Satisfied with your receiver? You're a most unusual ham if you answer yes! But with the present high cost of new equipment, and the apparent complexity of modifying the present rig, you're probably resigned to struggling along with what you have.

In the past couple of years, a number of excellent articles have appeared in the various ham magazines describing homebrew receiver projects. To cite just a few, there have been Ted Crosby's HBR units in QST, and the several fine units described in these pages by John Wonsowicz, W9DUT.

But most of these homebrew receivers appear to have two points in common (*besides* fine performance): they seem a bit too complex for the newcomer to homebrewing, and they all look more than a little expensive.

That's why the SJS was born; to be a simple, inexpensive receiver capable of serving as the only receiver at K5JKX, and still having enough quality to provide satisfactory performance.

To achieve these ends, a rather unusual looking device evolved. Simplicity was achieved by going to a modified modular type of construction, and the expense department was taken care of by raiding the surplus bins and the junkbox quite freely.

The result in terms of performance: stability is almost unsurpassable. From a cold start, checking against the 15 mc transmission of WWV, no drift was detectable after two minutes. Another check 10 minutes after turn-on showed the frequency to be about 200 cycles low; the receiver was again tuned to zero-beat and let run another half hour. It was still product-detecting the WWV signal with no change in audio note at the end of that time. This is frequency-meter stability, after the 10-minute warmup.

Selectivity is excellent although it could stand a bit of improvement for DX pileups on the lower ends of 20. The selectivity curve is fixed at approximately 4 kc, with steep enough skirts to do an effective job of deciphering DSB.

Sensitivity is determined entirely by the outboard converters used. On 50 mc, sensitivity is approximately 0.1 microvolt. On the lower bands, antenna noise is easily evident and no detailed checks were made.

You may have deduced by now that this is a multiple-conversion unit following the basic Collins approach, so the next question ought to be "How about birdies?" I have found two, neither objectionable. At first, there were many more, but if you follow the schematic and article you shouldn't have to chase them the way I did here!

And finally comes the question of image rejection. It's possible to find some images, but by proper tuning techniques they can be kept 40 db or more down; the kilowatt across town may pop up out of the band, but you won't find many commercials!

So now that you have the description of performance, let's take a look at the SJS itself.

Physically, it consists of two 3¼ inch relay rack panels plus an assortment of "miniboxes" hanging inside the rack. One of the panels contains the tuning/audio unit while the other contains the "intermediate converter". The miniboxes house the various outboard converters.

The tuning/audio unit began life as a BC-453 "Q-5er," but any resemblance between the present unit and the original command set is purely accidental. I used a "junker" 453 which had been given to me to get it off the shelves. The only parts of it retained are the capacitor gang, the rf-mixer-oscillator coil assembly, the three *if* transformers, and the bfo coil assembly. If the bypass capacitors are good you can use them too; I used several and substituted new Mylars for the rest.

The original circuit of the 453 was discarded and a new circuit (Fig. 1) was designed in its place. The new circuit uses a 6BA6 rf stage, hooked up conventionally, feeding a 12-AT7 mixer in the "Like New" circuit (73, October, 1961, page 32). The oscillator is a triode-connected 6AK5. The two *if* stages are both

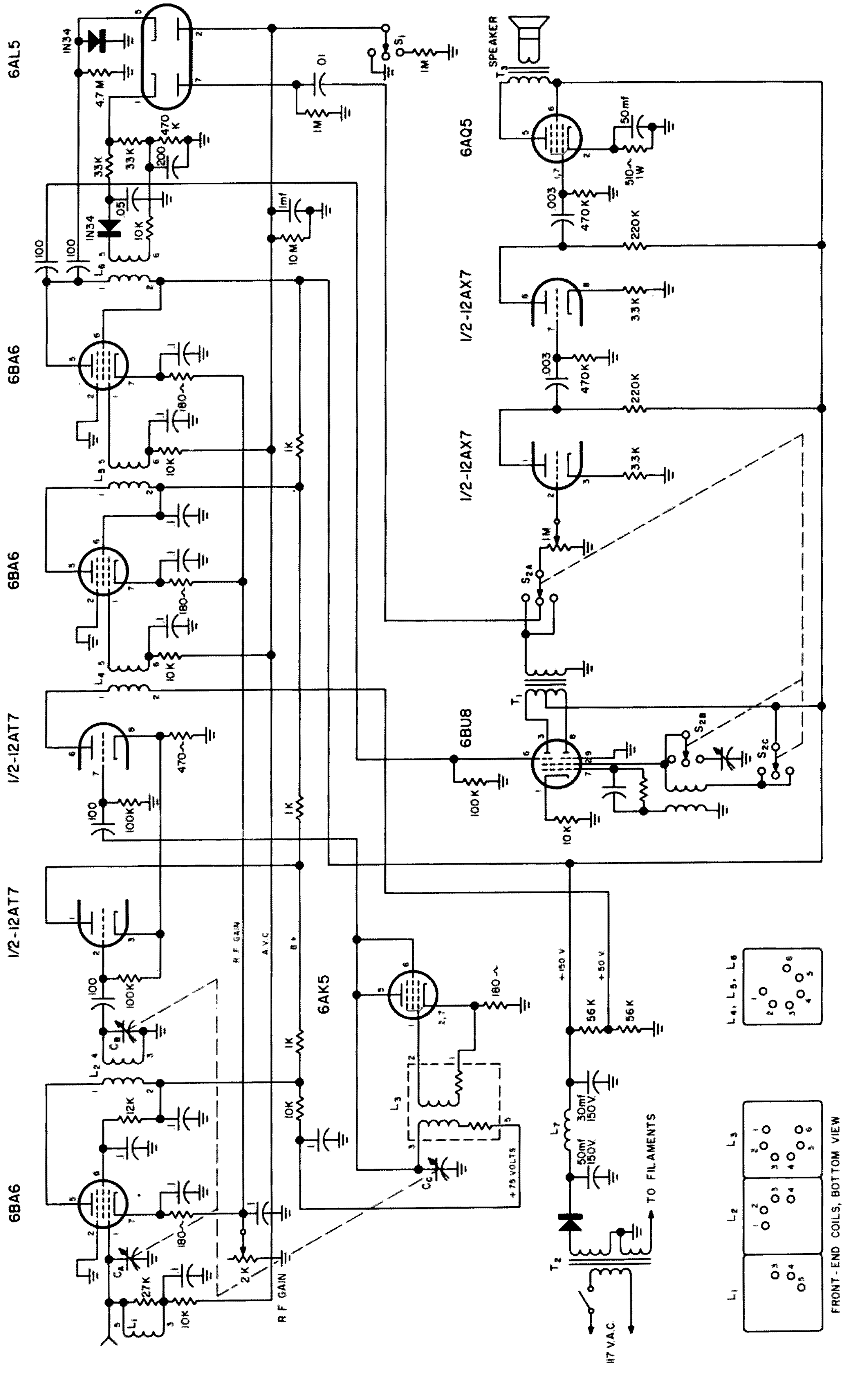

6AL5
6BA6
6BA6
1/2-12AT7
1/2-12AT7
6BA6
6AK5
6AQ5
1/2-12AX7
1/2-12AX7
6BU8
SPEAKER
RF GAIN
AVC
B+
+150 V
+50 V
+75 VOLTS
TO FILAMENTS
117 V.A.C.
FRONT-END COILS, BOTTOM VIEW

FIGURE 1

6BA6's and are completely conventional. They feed the AM detector through the final *if* can; this detector is the Makino circuit (Ultimate ANL, VHF Horizons, July, 1962). In addition, the last *if* plate feeds a shunt-diode AVC detector, and provides signal to the 6BU8 product detector.

Audio from the AM detector and from the product detector are both applied to the front-panel function switch; this switch also controls B+ to the bfo grid of the 6BU8, and switches a padding capacitor into or out of the bfo tank to select USB or LSB operation. This trick, incidentally, was borrowed from Alan Margot, W6FZA, and his article in the January, 1962, QST.

Audio from the function switch goes through a 12AX7 cascaded amplifier with voltage gain of approximately 1000, and drives a 6AQ5 power amplifier.

In the avc circuit, a diode and several resistors are combined to get a fast-attack variable-release action; the front-panel avc switch gives fast, slow, and manual action. The rf gain control is in the cathodes of the two *if* stages and the rf stage; the audio gain control is between the function switch and the first audio stage. The speaker switch merely opens the voice-coil leads to mute the unit for standby.

The power supply for this unit is also enclosed in the chassis; it provides approximately 120 volts at 50 ma, using a silicon diode and a tiny TV-booster transformer. The ac switch is on the rf gain control. The low voltage was chosen after studying Bill Barnard's article in the Command Set Handbook on "Repackaging the Command Set" for cool operation and lowest noise.

This tuner/audio unit may not sound so simple in the written description, but it shouldn't take more than 8 to 10 hours to wire it as all wiring is straightforward, point-to-point. The hardest part of all is installing the tuning capacitor gang and hooking up the front end. Detailed instructions will be given later.

As you can see by now, the tuner/audio unit takes rf energy in the range from 190 to 550 kc and gives you audio output. To be very useful, an "intermediate converter" is necessary, and that's the next unit.

W6FZA's article mentioned earlier describes an excellent "intermediate converter" he uses with a BC-453 to bring the 14 mc region down to the 453's tuning range; he reported (in private communications following appearance of his article) that he had no complaints after two years' service, and if 14 mc and higher is your prime interest, this would make a good unit to go ahead of the tuner.

However, I wanted to be able to listen on 40 as well, which would have required major redesign of the W6FZA unit. In addition, I wanted my "intermediate converter" to match the tuning unit in general size and appearance. Therefore, I designed my own.

It consists of a 6BJ6 rf stage, operated grounded-grid (idea from W6AJF's VHF Handbook), with a tunable band-pass circuit in its place. This stage feeds a 12AT7 "like new" mixer, while a second 12AT7 serves as crystal oscillator and cathode follower for output.

The front-panel controls are band-pass tuning (at left) which operates just like an an-

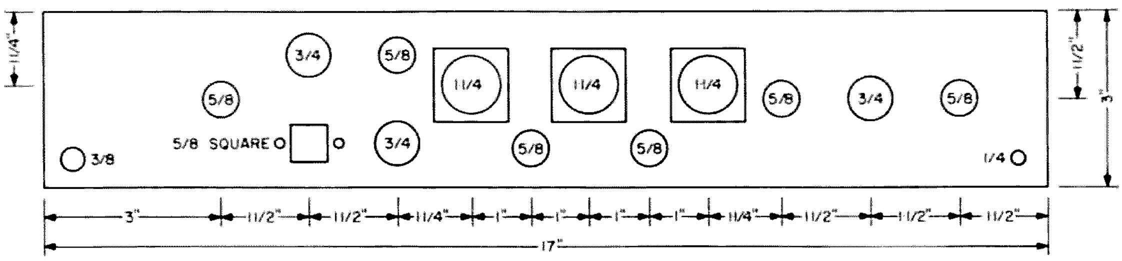


FIGURE 2
REAR-PANEL LAYOUT

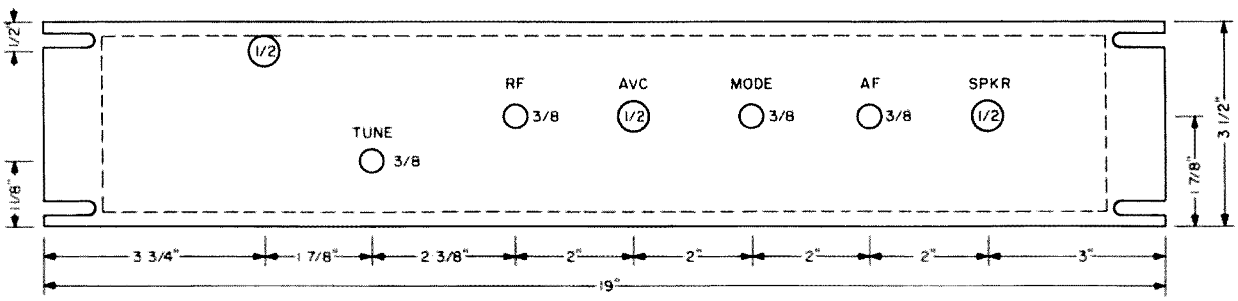


FIGURE 3

tenna trimmer, to peak up the rf stage and mixer at the same time; the bandswitch, which selects one of three crystals (6800, 7150, or 7500 kc) for the oscillator and simultaneously pads the band-pass circuit to the right region, the converter switch, which selects one of five outboard converters as the input, and the power switch.

For this unit, a 250 volt power supply was chosen and built in; this supply powers not only the intermediate converter, but any outboard converters which do not include their own supplies. Regulated 150 volts, unregulated +250, and filament voltage are available on back-panel connectors. Filament voltage is always on, while both B+ voltages are switched by the converter switch.

The intermediate converter covers the range 7 to 8.05 mc with no outboard converters attached, allowing direct listening on 40 meters. In addition, any frequency coverage desired can be achieved by putting a converter with 7 mc output ahead of it. As this is written, I am using a 50 mc converter on position 1. Position 2 is vacant. A 14.9-15.9 mc converter (International Crystal KB-1 board with 7900 kc rock) is in position 3 for WWV checking (and some SWL activity), and position 4 connects directly to a 40-meter antenna. Position 5, like position 2, is not in use.

While it might appear from this description that operation would be complex, it isn't. To turn the rig on, the tuner rf gain and the intermediate-converter power switch are both rotated clockwise. When the unit warms up, the band of interest is chosen by the converter switch, and is tuned by the tuning knob on the tuner. The desired signal is peaked with the band-pass tuning control. If a signal peaks with this control clockwise while it is tuned at the low-frequency end of the range, you are on an image. It will go away if you simply move the band-pass tuning to correspond with the main tuning control.

Ready to build it (or a similar device with some of your own modifications)? Let's go!

The starting place is the tuner/audio unit, since this can be used in Q-5er fashion with your old receiver until you complete the intermediate converter. Gather your junk BC-453, a 6 × 3 × 17 chassis, appropriate tube sockets and hand tools, and let's get to work.

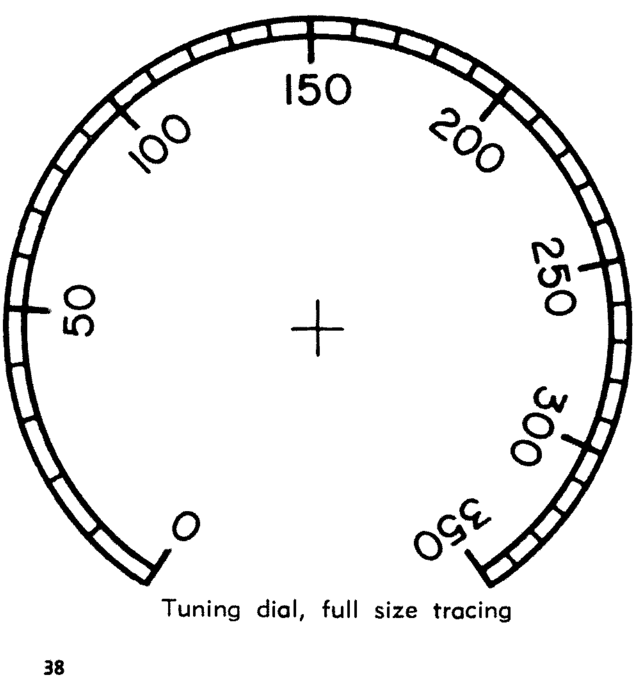
First, strip the necessary parts from the BC-453. Start by removing the *if* cans; they come out easily from their plug-in sockets after you remove the two small screws (top of chassis) at the corners. Next, remove the two screws at the sides of the chassis and unplug the front-end coil assembly. Now you can re-

move the bfo coil assembly by removing four screws (don't lose them!) and all bypass capacitors. Check the bypasses with a neon bulb and a 150 volt source to make certain they aren't leaky or open. A good one will let the bulb blink once, but no more. Any glow, or lack of the initial blink, indicates a bad bypass.

We've saved the hardest part, removing the capacitor gang, till last. Remove the tuning dial. Behind it, you will find four small screws on the panel. Loosen them but do not remove them yet. Now check the connections to the capacitors. The rf and mixer connections can be removed at the capacitor, but you want to retain as much of the original oscillator wiring as possible. On mine, a No. 12 wire ran down to a feedthrough on the chassis, and disconnecting it from the feedthrough let me lift the whole unit free. When you are certain you have the wires under control, remove the four screws and lift the capacitor free.

Next step—and if it's late in the evening wait till tomorrow because it's really the hardest part of the whole job—is to drill and shape all the holes in the chassis. The rear-skirt layout (Fig. 2) and the panel template (Fig. 3) should be of help here. After all holes are drilled or punched, smooth off all burrs and mount the tube sockets.

Now the wiring begins. Run the filament line first. After it is complete to all sockets, add the 6AQ5 output stage components, including the audio output transformer. Now, wire in the power supply in the space between the output transformer and the 6AQ5 socket (and as you do this, you will understand why this order was prescribed—the 6AQ5 socket is inaccessible after the power supply is installed!).



Tuning dial, full size tracing

After checking to see that all filaments light properly, remove tubes and disconnect ac power (short out the filter capacitors, too, for safety). Install the "W2EWL" transformer and wire all B+ lines, dressing the wires and decoupling components as close to the chassis as possible. Now you can finish up the 12AX7 audio stage, and reinsert the two audio tubes for a checkout. If all is well so far, you should be able to get a loud hum by touching the input grid of the 12AX7 with a screwdriver.

At this stage, add the volume control and speaker switch on the front panel and connect them in. You now have a fine audio amplifier ready for service; the next few steps will turn it into a receiver.

Next step is to wire the 6BU8 stage, and insert the last *if* transformer in its chassis hole and connect it. The Makino-limiter/AM detector is hooked up separately on a five-point tie strip and installed after this wiring is completed.

The other *if* transformers can be mounted now; hold them in place with 4-40 screws and nuts through the mounting lips, and connect by soldering directly to the "sockets" on the bottoms of the coils. Install the rf gain control, the avc switch, and the function switch on the front panel, and wire the *if* stages and the controls into the circuit.

The avc components can be added conveniently at this stage also. They fasten to a tie point on the bottom of the chassis, to the tube socket, and to the avc switch.

All that remains is the front-end wiring. Make all possible connections to the tube sockets. Connect generous lengths of insulated wire to all tube-socket pins which have any connections to be made to the coil assembly or capacitor, since you won't be able to get to them later.

Now angle the tuning capacitor into position. Before installing it permanently, you'll probably want to add a dial as I did—just trace off the calibration from the original dial plate, except that the old "200" mark becomes "O" on the new dial and you go up from there, so that the dial reads from 0 to 350. I used "letra-set" lettering and copied the final tracing with an office-copy machine, then glued the copy to drafting board and forced the board into place on the threaded hub of the tuning capacitor.

The hairline indicator behind the viewing hole in the front panel was made by scratching a line on a piece of lucite. The whole works is held in place by masking tape against the inside of the chassis, and a No. 47 bulb across

the filament circuit illuminates the dial from below.

To hold the capacitor in place, I used 4-40 screws 1 inch long, with ¾ inch tubular spacers to hold the capacitor back from the panel and allow room for the dial. A short shaft extension clamped to the splined shaft runs out to the big spinner knob for tuning.

With the capacitor mounted, the coil assembly is positioned so that the rotor just clears the shield case and is fastened in by a single screw through the end of the chassis. Connections to the capacitor, coil assembly, and front-end tubes are then completed.

The low voltage applied to the local oscillator is low for a purpose; originally, the full 120 volts was applied. The result was more birdies than I had ever heard before. Oscillator voltage was lowered (by adding series resistance) until the birds disappeared. Gain was not affected. Thus, if you should find a bird or two, try increasing resistance in the oscillator plate supply line and they will undoubtedly go away.

Now, after checking all your wiring, you're ready to fire up your tuner/audio unit and try it out. Connecting directly to an antenna will let you hear radio range stations operated by FAA and the military, and you can check frequency calibration against these. Don't be misled by "bassy" audio though; these stations feed high-Q antennas and they lose the sidebands at the transmitter. Audio quality will be excellent with the unit in use on higher bands.

As mentioned earlier, you can use this unit as a Q-5er, or (if your interests are all at 14 mc and above) you can put together the W6-FZA intermediate converter. Other intermediate converters already in print for this range include Don Stoner's "Novice Q-5er" and a later version in his "New Sideband Handbook."

However, if you want to follow this unit all the way through, you'll want to build the SJS intermediate converter. It's a little long to describe here—so we'll break at this point until next month. And in the meantime, happy listening!

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Another Antenna of Note

or Why did we ever move off the olde farm?

Having more wire than brains, and being of unsound mind (at least I was told this more than once), a monstrous idea formed in my mind one day, and unlike most of such, it was actually carried out. The 20 meter VEE beam has been described in the literature (73 Magazine for March, 1962) and one would be quite sure it was enough to dampen my enthusiasm for any more antenna projects. Wrong! That beam wouldn't load up on 80 or 40 worth two cents. For years a roll of #18 copper coated steel wire had been kicked about under the workbench and had been almost chucked out many times. One afternoon, while sitting at the operating position biting my fingernails to the quick and wishing I could get on 80 meters (all the good DX on 20 had already been worked twice that day) I spied that miserable roll of old wire. The rest is history. . . .

The handbooks were again consulted for some rule-of-thumb guides as to antenna lengths. As every Novice knows, or should, a ½ wave on 80 meters is about 132 feet long, and once cut will also load up on 40 and other bands. Having spent my last thin dime on the 20 meter VEE beam, I was looking for something simple and this couldn't be much simpler. One end was attached to the peak of the house and the other end was run out to . . . ? And that's how the thing got started. There just wasn't any kind of a sky hook in the 132 foot range.

A tear welled up in one eye, and the idea was about to be dropped and a new hobby pursued, when by chance a hawk flew overhead. I idly watched that hawk as he glided and soared effortlessly overhead and finally as if guided by providence he flew in a line from

over the peak of the house in the direction my wire was lying on the ground, due east. As my eyes followed him he flew about 500 feet due east and alighted in the top of a tree growing at the top of a 150 foot hill.

My interest in ham radio and antennas dropped to a low level as I became interested in finding out if that bird had a nest in that tree. I started out on a trot for the tree on yon hill, and after about five minutes of puffing along had reached my goal. The bird had by that time flown off, and I set out to climb the scrub oak as it turned out to be. From my perch about 25 feet up I surveyed the countryside all around and was suddenly struck by a stupendous idea! Why not run my antenna from the house to the tree I was ensconced in?

A pulley was mounted in the tree and fitted out with some rope and the antenna wire was pulled skyward. With a wire 545 feet long there was some question in my mind if the stuff could even support its own weight without breaking, let alone keep from being so sway-back in the middle that a center support would be required. Lo and behold though, due to the small gauge wire used, it was apparently light enough to almost float on the breeze. The tree, being on a 150 foot rise was high enough so that the wire never came closer than about 30 feet from the ground at any point, and actually sloped down hill to the house. When the wind would blow vigorously, one end of the wire might be rising while the other end could be dropping, or one end could be still while a local gust at the other end was whipping the deuce out of the far insulator. Small birds produced a curious reaction, which I chose to call the Banjo Effect. The first bird to alight on the wire caused a mild trauma in our household. The wire, it seemed, was resonant at some medium audio frequency, and when excited by the bird's feet, would produce a loud note, which was amplified by the walls of the house. You will recall the house was one of the antenna supports. When more than one bird landed simultaneously on the antenna, a strange symphony of atonal music would be produced, and I must admit in the middle of the night it was rather spooky.

Then there was the South Wind Effect. A south wind would cause a continuous pure note to be emitted at approximately A above middle C! The effect was similar to tuning in WWV at loud volume and leaving it that way for hours.

Now, to say that this antenna was popular with the rest of the family was not quite accurate. They couldn't seem to sacrifice at all for the sake of some outstanding 80 meter contacts, which incidentally were quite remarkable.

Then came the day I was up on the roof tightening up the monster. You see it stretched out about 1 inch per week, and required pulling up frequently. I calculated that at that rate it would have lasted for at least 5.78 years, but as we shall see it didn't reach that critical old age. It was nearly dark as I stood up there twisting the wire back through the insulator, and as far as I could see it was perfectly clear except for some clouds miles away on the horizon. Suddenly I was jolted out of my skin

by a shock which seemed to have more kick than the day I fell across my 700 volt plate supply and passed out on the bed! I almost leaped off the roof! But luckily I was able to hold on and regain my composure. Then out of curiosity I watched the clouds on the horizon some miles away. A flash! And a funny noise from the antenna insulator! That heat lightning some 10 miles or more away was inducing current in that long wire.

Some fast thinking was in order . . . what if a near-by storm should come up? Good grief, the rig and perhaps the house would melt! In I went and out the window I came with my wire cutters; the noble experiment was over. With an agonizing slither the wire dropped and pulled itself through the hay field. Again I was stuck on the 20 meter band.

Oh! Incidentally, the hawk didn't have a nest in that scrub oak after all.

Tuned Line Tank Circuits

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A tuned-line makes a very efficient tank circuit for VHF transmitters. Moreover, since it can be made of inexpensive materials obtainable at any auto supply or hardware store, it can often be the most convenient and cheapest tank. Finally, with proper design it can provide operation on two bands at no additional cost worth mentioning.

In view of all these advantages, tuned-lines ought to be widely employed in home brewed transmitters. Unfortunately, many hams are scared off because tuned-lines seem to be a mystery to them. Actually, no great knowledge is required to design a tuned-line tank and it is rather easier, if anything, to prune and adjust than the conventional coil-condenser tank.

Let's take a look at Fig. 1A, the circuit of a closed-end quarter-wave transmission tank. Then look at Fig. IB which is the circuit of an amplifier with a conventional coil-condenser tank. If we unwound the coil and stretched it out to make a hairpin loop, it would look exactly like the closed-end transmission line. Conversely, the transmission line is basically identical to the circuit of the coil-condenser amplifier. The line can represent the wire in the coil. There is capacitance between the two conductors of the line, between each conductor and ground, and finally, there is capacitance within the tube from each plate to ground. Substituting all these in an equivalent electrical circuit we get the diagram of Fig. 1C which, obviously, is identical with that of the coil-condenser circuit. Thus we can say that a coil is merely a closed-end transmission line folded to a small dimension. A closed-end quarter-wave line is a coil or inductance stretched to its greatest dimension. In any event, a closed-end transmission line will behave exactly like a parallel-resonant circuit at a frequency for which the line is *effectively* a quarter wavelength long.

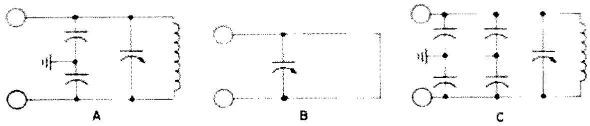


FIG I

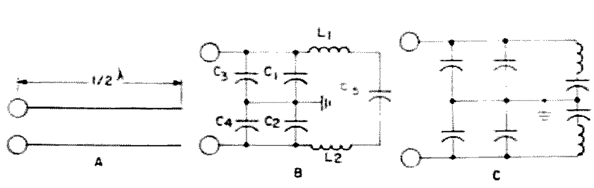


FIG. 2

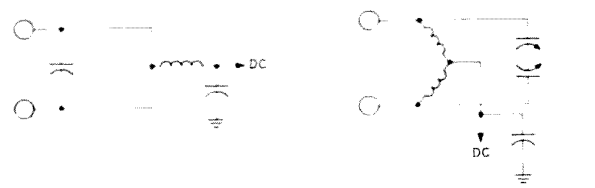
So far so good, but ordinarily we want to operate over a range of frequencies—say from 50 to 54 mc or 144 to 148 mc. How are we going to vary the frequency of the tuned line? Exactly the same way as we vary it in a coil-condenser tank—either by varying the inductance or the capacitance. We can change the in-

ductance by stretching or shortening the line. This can be done by making the line long enough to resonate at the lowest frequency, and then shortening it by moving a shorting bar across the far end. Much more simply, however, we can also vary the capacitance simply by adding a variable capacitor across the line.

It happens that an open-end line a half-wave long also behaves exactly like a parallel resonant coil-condenser tank; the only difference being that the tank is split. Fig. 2B shows the equivalent circuit. Here L1 and L2 are the inductances of the two conductors of the line; C1 and C2 are the capacitances between each conductor and ground; C3 and C4 are the capacitances of the output tubes to ground; and C5 is the capacitance between the two conductors of the line. Transposing this to a more familiar form we get the circuit of 2C which is equivalent to that of a split tank parallel resonant circuit. How do we change frequency? We can stretch or shorten the line, and at the same time vary the capacity, by connecting a variable capacitor from each end of the line to ground or across the open end of the line. You can look at the effect of this capacitor in either of two ways: simply as an added capacitance across the inductances in the circuit, or as a device which stretches or shortens the line by changing the reactance the signal faces.

One thing remains. To work out a completely practical circuit. We must feed the two amplifiers with input power. The proper point at which to feed such a circuit is the electrical center. In the case of the closed-end tuned line the electrical center is in the center of the line. Hence, we can feed dc voltage at this point. Thus we get the practical quarter-wave tuned line circuit of Fig. 3A.

In the case of a half-wave open end line the wave pattern along the line is such that the rf cold point is just about at the electrical center of each conductor. Therefore, we will feed the dc at this point through a pair of chokes and hence the practical half-wave open-end tuned line circuit looks like Fig. 3B.



A PRACTICAL QUARTER-WAVE TANK   B PRACTICAL HALF-WAVE TANK

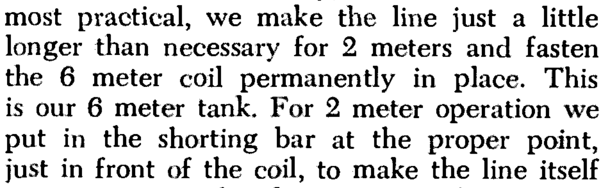
FIG. 3

Two-Band Operation

Before getting down to the practical aspects of designing and adjusting a tuned line tank, let us first see how it is possible to operate such an amplifier on two bands.

First take the case of the closed-end quarter-wave line. Obviously we can make the line long enough to resonate in the lower of two bands, and then move the shorting bar to shorten the line so it resonates on the higher band.

In the case of 6 and 2 meter operation, we can take still another approach. With the end closed as we have looked at it up to this point, we can design the line to resonate in the 2 meter band. Now suppose we open the line by removing the shorting bar at the end, and replace the shorting bar with a center tapped coil. The two sections of the line will be connectors connecting the coil to the condenser and the condenser to the tube plates. They will have some inductance which will add to the inductance of the coil but since they have a relatively large cross section, the inductance will be quite small. If the coil we put at the end is properly designed we can tune the circuit to the 6 meter band, with the same tuning capacitor we used to tune the line to 2 meters. Actually, to make the circuit most practical, we make the line just a little longer than necessary for 2 meters and fasten the 6 meter coil permanently in place. This is our 6 meter tank. For 2 meter operation we put in the shorting bar at the proper point, just in front of the coil, to make the line itself resonant on 2. Thus by removing the shorting bar we get 6 meter operation, and with the shorting bar in place we get 2 meter operation. The shorting bar, of course, shorts out the coil, but the choke still feeds the electrical center of the circuit with dc current.



6 & 2 METER QUARTER-WAVE TANK

6 & 2 METER HALF-WAVE TANK

FIG. 4

The necessity for adding or removing the shorting bar is eliminated with an open-end half-wave line. Again we design the line to resonate as a half-wave open-end line in the 2 meter band. All we have to do to provide for 6 meter operation is to substitute a split tank coil for the two chokes at the dc feed point. The coil, with the inductance of the line and the capacitor at the far end, forms a parallel resonant coil-condenser tank on 6, or a lower band for that matter, if the coil is of a suitable size. The coils simply act as chokes on 2 meters. Thus this tank will deliver output either on 6 or 2 depending on the excitation. With 6 meter excitation it will deliver 6 meter power; with 2 meter excitation it will deliver 2 meter power. All we have to do to change bands is to change excitation.

Thus a tuned line gives us as a bonus, without much added complication, operation on two bands instead of one. We can design a transmitter with the primary idea of 6 meter operation and still provide for efficient two meter operation or vice versa.

So much for theory. Now let's get down to practical considerations. The first decision that you will have to make is whether to use the quarter-wave or half-wave line. This will depend partly on the avalable space, and partly on convenience in band-changing. A quarter-wave line is obviously shorter and will occupy less space in the transmitter. The quarter-wave line is the simplest choice until we get into the UHF range where it may be too small to provide a good arrangement. The quarter-wave line may be used on two bands either by moving the shorting bar or by removing the shorting bar and substituting a coil resonant in the circuit on the lower band.

The half-wave line cannot be used conveniently as a tuned line on two bands. We would not only have to move the condenser along the line, but also the two chokes because the dc feed point will also change with frequency. However, it is very convenient for 6 and 2 meter operation because it is possible to change from one band to another without switching, moving shorting bars or anything else—merely by changing the excitation fed into the amplifier.

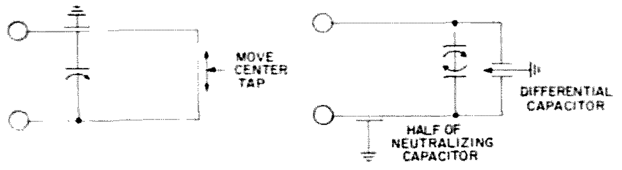


FIG. 5 BALANCING THE LINE

How Long a Line

The formula for transmission line lengths is the same as for antennas. A half wave line would be: $\frac{492}{\text{F in mc}}$

and a quarter wave line would be: $\frac{246}{\text{F in mc}}$

However, a practical tuned line tank is always very much shorter than this. This is because the capacitances shorten the line, and there is always a certain amount of inductance in the leads from line to tubes and in the capacitor. As a rule the half-wave line will be only about a quarter-wave long and the quarter-wave line will be roughly an eighth-wave long.

For example, a half wave line at 144 mc according to the formula would be some 34 inches long. A quarter-wave line some 17 inches long. In practice—with typical transmitting tubes, tuning capacitors and layout arrangements—the half-wave line will be something between 14 and 20 inches long and the quarter wave line between 7 and 10 inches long. This shortening of the practical line makes a quarter-wave line quite practical on 6 meters since it would be some 20 to 30 inches long instead of the 50 to 60 inches that you might expect from the formula.

It would be possible to determine the actual length mathematically, but it is much more simple to do it by cut and try. For example, take the case of a half-wave line to be used in a combination 6 and 2 meter transmitter. For a good Q on 6, where the circuit will be a coil-condenser tank, the capacitance ought to be between 15 and 25 mmfd. So we chose a split stator or butterfly variable condenser in this range. For the first trial we can take two pieces of tubing or strap about 20 inches long, or longer, if you want to play safe. With appropriate temporary straps, connect one end of each piece of tubing to the stators of the condenser, and the other end to the plates of the amplifier tubes (being sure that the cathode of the tube is grounded so that the plate-to-ground capacitance will become part of the circuit). This can be done in a temporary breadboard arrangement on a table or bench top. Take your grid dip oscillator and couple it to the line in the middle. Turn the tuning capacitor to nearly minimum capacitance and tune the gdo to resonance as indicated by the dip on its meter. The chances are that the dip will occur at a frequency lower than 144 mc, indicating a line that is too long. Cut an inch off the ends of the tubing and try again. Keep this up until the gdo shows that the line resonates at around 148 mc with the tuning capacitor near minimum capacitance. Tuning the capacitor to high capacitance will lower the frequency and you should get enough spread to cover the entire 144-148 mc band. You now have approximately the right length of line. You can prune it exactly when you mount the tubes, condenser, etc., on the chassis.

Pruning a quarter-wave line is easier. Start with the line about 12 or even 14 inches long. The most convenient tuning capacitor is a neutralizing capacitor taken apart and mounted on the two lines so that the two discs are between the two lines and can be moved toward each other for tuning. The capacitor is mounted as close to the tube end of the line as is convenient without getting the capacitor too close to the tubes or other components. If you use bar stock or strap, the normal kind of capacitor can be mounted on top of or below the straps and directly to them.

Couple the gdo to this line. Turn the tuning capacitor to near minimum capacitance. Take a piece of metal and short the far end of the line. Resonate the gdo. If, as is most likely, the line resonates at a frequency below 144 mc, move the shorting strap to shorten the line; repeat resonating with the gdo until you find the point where the line resonates at 148 mc with the tuning capacitor near minimum capacitance. Now tune the capacitor to see if you get coverage of the full 2 meter band. Cut the line about an inch longer than indicated to provide a safety factor for final pruning and also, if you are going to use the cricuit on 6, space for mounting the 6 meter coil.

Finding the Electrical Center

With the line of approximately the right length, you can now arrange your parts on the chassis and mount the tubes, condensers,

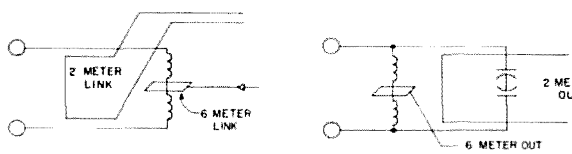


FIG. 6 LINKS

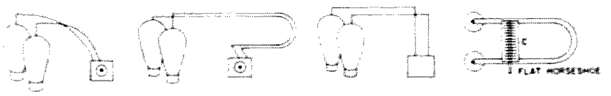


FIG 7 VARIOUS ARRANGEMENTS OF TUNED LINE TANKS

etc. The line can be bent if necessary to provide a suitable arrangement or to save space. Though circular bends are preferred, you can use right angle bends if they are necessary.

When you have everything in place you can do the final pruning with the gdo so that you can cover the entire 2 meter band with the range provided by the tuning capacitor. Having done this and fastened everything down in final form, couple the gdo to the line (not too tightly). Resonate the line to about 146 mc as indicated by the dip on the gdo. In the case of the quarter-wave closed-end line, the electrical center should be in the center of the shorting bar. You can check this by taking a long screwdriver, and touching the chassis with one end and the shaft to the center of the bar. If the tank is balanced, doing this will not change the reading on the gdo meter. If it is *not* balanced exactly, the meter needle will move up or down. Move the screwdriver to one side or the other of the center. Find the point at which the meter reading is the same when you touch the shorting bar with the screwdriver as it is when the screwdriver is removed. This is the precise electrical center. You can if you like, attach the dc feed point here. Or, you can balance the line, so that the feed point does come at the center of the shorting bar.

The line can be balanced in several ways. You can prune one of the tubes or bars slightly. Or you can skew the shorting bar slightly so that one line is shorter. Or, you can add a balancing capacitor. This can be a strip of copper or aluminum strap grounded at one end and mounted so that the other end is close to one conductor, and can be moved closer or farther away from it by bending. The balancing capacitor should be on the side of the line that is shorter. By adjusting this capacitor you can move the electrical center until it comes exactly in the middle of the shorting bar.

When the quarter-wave line is used with a coil for 6 meter operation, the electrical center should be at the center tap of the coil with the shorting bar in place. You can move the tap on the coil, or balance with the capacitor as above. At any event, the point is to have the dc feed point at the precise electrical center so the two sides of the circuit will be balanced and, also, so that the choke will be at the rf null and hence will not be heated by an unbalanced rf voltage.

In the case of the half-wave line, the procedure is a little different. Having done your final pruning of the line so that it covers the desired band with the capacitor, couple the gdo and resonate the line in the middle of the band. Now take a lead pencil and run the point along one of the conductors. Watching the gdo meter you will note that the reading will change as you move the pencil along the line. At one point, however, the meter reading will be exactly the same whether the pencil touches the line or is removed. This is the electrical center of that side of the line. Mark it exactly. Do the same thing on the other line and mark the electrical center there. These two points should be opposite each other if the line is balanced. If it is not balanced you can add capacitance to one side with the piece of copper or aluminum strap until the two centers are opposite each other. These are the points where you will feed the dc and, in the case of a 6 and 2 meter amplifier, where you will have your 6 meter coil. In any event you can arrange to mount the chokes or the coil at exactly these two points.

The fact that you can so easily balance a tuned-line tank is one of the reasons why a tuned line can deliver high efficiency. A balanced tank will deliver most of the power to the load, whereas an unbalanced one will dissipate a good deal of power in the tank or choke.

If you are going to operate on one band only, you can connect your chokes to this electrical center and get on with the job. But if you want to operate on the lower band, the next step is to probide the coil for the lower band.

In the case of the quarter-wave line, remove the shorting bar. Make a trial coil and attach it to the end of the line, grounding the center of the coil through a .0005 to .001 capacitor. Couple the gdo to the coil, set the tuning capacitor for about ¼ capacitance and dip the gdo. You want to hit 54 mc. Prune the coil by adding or removing turns, by compressing or expanding the turns, until the combination does resonate at 54 mc—somewhere between ¼ and ½ the range of the tuning condenser. You should be able to hit 50 mc with the capacitor advanced to higher capacitance. When you have a coil that provides this range with enough capacitance to provide a good Q, change the gdo range to the region of 150 to 400 mc. Sweep the range to make sure that the line does not resonate at

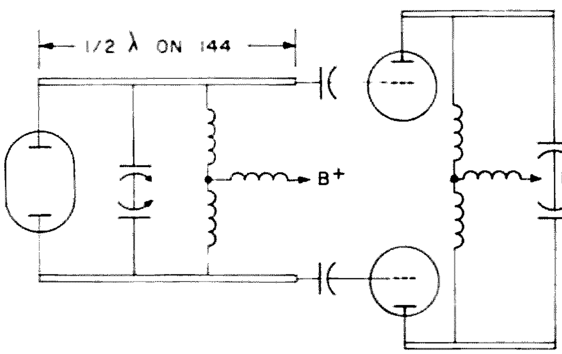


FIG. 8 HALF-WAVE LINE COUPLING OF DRIVER AND FINAL

some harmonic of 50 mc. If it should resonate at the same setting of the capacitor at the 6 meter fundamental and a precise harmonic of it, change the coil by adding or reducing inductance so this will not happen. Acutally this is not likely to be the case, but it should be checked so that you will not be accentuating an illegal harmonic.

With the coil pruned, put the shorting bar in place. The circuit should still resonate in the 2 m band. The circuit is right when you can cover the whole 2 m band with the shorting bar in place and the full 6 m band with the bar removed.

In the case of the half-wave line, the procedure is similar. Having tuned the line to cover the 2 m band, wind a trial 6 meter coil and connect it at the electrical center points of both lines, with the center tap to ground through a condenser. Couple the gdo to the coil and prune the coil until you can cover the 6 m band with the proper range of the capacitor. Remember that you should have enough capacitance in the circuit to keep the Q good. A half-wave line could well resonate at the third harmonic of a 50 mc signal, so be sure that when the circuit resonates in the 6m band, the line itself resonates well below 150 mc. If you prune the line to resonate at 148 mc with almost minimum capacitance, and the coil so it resonates in the 6 m band with half capacitance or more, you will eliminate this possibility.

When you have your final coils in place, check the balance of the line. Balance it if necessary with the added capacitor as pointed out earlier.

Tuned lines can be used in grid or plate circuits or both. You can use a quarter-wave line in the plate circuit and a half-wave line in the grid circuit, or vice versa, as convenience dictates. You can also use conventional coil-condenser tanks in the grid and tuned lines in the plate circuits.

The adjustment of tuned grid lines is exactly the same as the adjustment of plate lines. Be sure to do your pruning and adjusting with the tube in place and the cathodes grounded for rf, so that the grid to ground capacitance is part of the circuit.

Tuned lines are most conveniently made of copper or brass tubing which is available in diameters from ⅛th to more than 2 inches. The size depends on the power in the circuit and the efficiency desired. The larger the tubing the smaller the skin-effect losses, and therefore, the higher the efficiency. Tubing of ½ inch inner diameter (or larger) will serve for amplifiers up to the full gallon. Tubing with an inner diameter of 1¾ inches is especially convenient to use with 4 x 150's and 4 x 250's. If one end is slotted by making two or more hack saw cuts about an inch deep, it will slip right over the radiator-anodes of these tubes and can be clamped tight with an automobile radiator hose clip. The cooling air, after passing through the cooling fins, will go through the lines and out the far end—so be sure that the air can escape the far end without obstructing the air-flow.

The lines should be spaced about 3½ to 4 times their diameter for highest efficiency but this spacing is not too critical and a small variation or departure for convenience in layout arrangement will not make a big difference.

An elegant way to balance a tuned line is with a small differential capacitor as shown in Fig. 8. This is easily done in grid lines since the voltages are low and small differential capacitors can be used. In plate lines where the voltages are high, suitable differentials may run into money and, for that matter, may not be available at all. One of the discs from a disc type neutralizing condenser makes a fine balancing capacitor.

The entire tuned line, with its condenser, tubes, etc., should be shielded. Otherwise it will radiate power. Perforated cane metal make a satisfactory shield for small lines. However, a solid metal shield may be preferable for larger lines because the cane metal shielding may vibrate and change the capacitance from line to ground—thus changing the resonant point or the balance or both. Final adjustment and pruning should be done with the shield in place.

Links

Tuned lines are usually coupled to the antenna or a preceding driver or exciter through a link. The links are hairpin loops placed close to the tuned lines at a high voltage point. Coupling is varied by moving the links closer or farther away from the lines. This

can be made variable through a suitable mechanical arrangement. In the case of combination 6 and 2 meter tanks, using coils for 6, the 6 meter link goes to the center of the 6 meter coil as in any conventional coil arrangement. In 2 band tanks, the 6 meter link can go to the coil, and a separate 2 m link to the line. Thus the two antennas can be fed by separate links. The links to the line (or coil for that matter) can be single-ended or balanced. The 6 meter link can be single-ended to feed a coax cable. The 2 meter link can be balanced to feed a 300 ohm line. Similarly, the links on the grid tank can be arranged to provide separate 2 and 6 m excitation. A half-wave line may be used between the driver and final without links as indicated in Fig. 10. It can work both on 6 and 2 with 6 m coils in the center; in which case the driver can work straight through on 6 and triple on 2 by changing bias.

Lines can also be made of bar stock, or heavy strap cut from copper or aluminum plate. Grid lines especially, are conveniently made from 16 to 18 gauge copper or aluminum strap from ½ to 1½ inches wide. On the 1¼ m and higher bands, a quarter-wave line can be cut out of flat stock in the form of a horseshoe, and pruned by snipping off bits of the open end.

For highest efficiency, tuned lines should be silver plated. Copper and brass can be silver-plated, aluminum cannot. It will cost about $3 to silver plate a quarter-wave 2 meter line, and about $6 for a half-wave line using up to 1 inch diameter tubing. The plating need not be heavy; a coating which covers the entire surface is enough.

When lines are used with high power, it is best to silver solder any joints. Soft solder joints, if they should happen to be a point of high rf potential, could melt out—especially when the tank is tuned without a load and has to dissipate the entire rf output of the transmitter.

To summarize, tuned lines are very efficient tanks at VHF and UHF. They make possible convenient and inexpensive two band operation. They can be designed and adjusted quite simply with the aid of a gdo. If you're thinking of a new 6 meter rig, why not get some copper tubing from your auto supply dealer and try a tuned line tank, so that you can have 2 meter operation as a bonus.

I Absolutely Refuse To Give Up Ten Meters

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Long ago, before I lost all my senses and began pouring all of my money into ham gear, I was fascinated by TV DX. For that matter, I still am. I suppose the six meter band's proximity to the TV bands is what prompted my interest in 50 mc work. At any rate, a few weeks ago I found myself faced with a mad desire to get on six for the summer E-skip openings, but only a Viking II, an SX-99, a Knight VFO, and an assortment of low frequency antennas.

This collection was not at all abetted by the strange lightness in my left rear pocket caused by deficit spending. The situation became a bit less desperate when I recalled W4WKM's article in the October, 1962 "73" describing the use of a Standard Coil TV tuner as a VHF converter.

After ripping apart an old Admiral TV set, I discovered my problem was rapidly diminishing. I found that almost no work was needed to use the tuner as a converter. Not to discredit Roy's fine work, it was merely necessary to connect the tuner's *if* output to the antenna post on the receiver through a length of coax, ground the AGC lead, apply power, and adjust the channel 2 oscillator slug.

Six meter signals came roaring in between 22 and 26 mc on the SX-99. Stability is not spectacular, but in all other respects the tuner seems to be the equal of most low priced commercial converters. (A few days later I discovered that putting an OA2 VR tube in the B plus line made the converter as stable as Gibraltar after just a few minutes warm

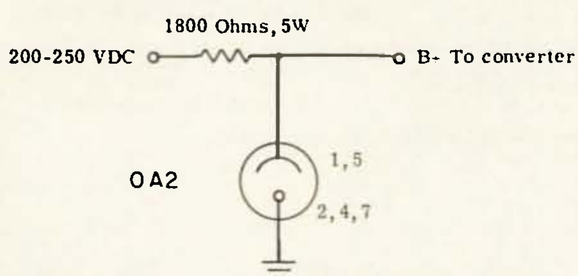
up.) Anyway, I was now hearing six meter signals. (Incidentally, the TV set cost $2.50. Not bad for a converter and a junk box, eh?)

For some reason, I thought getting a signal out was going to be a little more difficult. I designed a little rig based around parts out of the same TV set. Unfortunately, I still had to buy some parts to get the rig working.

Now, my XYL is very understanding when it comes to unfeminine metal objects invading our sleeping quarters, but she is partial to eating three square meals a day. The six meter rig met with a violent veto.

After a week or so of feeling sorry for myself, I got into a QSO with Phil W9GCG, who had recently converted his Viking I to six meter operation.

"No," I screamed, "I absolutely refuse to give up ten meters!"



Regulated voltage for the TV tuner converter

Well, Phil calmed me down by announcing that it wasn't necessary to lose any coverage. After about ten minutes worth of experimenting, I came up with even a simpler conversion than Phil had offered. It should be of interest to Viking I and II owners, and of course the principles are applicable to most rigs that have ten meter coverage and adequate grid drive.

The conversion takes a great deal longer to describe than to accomplish. The Viking rigs have a small coil for ten meter tuning mounted at the rear of the pi-network tuning mechanism. Shorting out this coil allows the final to double 25 mc signals (easily produced when the bandswitch is in the ten meter position) and still perform normally on all other bands. (The pi-network arrangement on most other rigs being a bit simpler, shorting out the ten meter coil would of course effectively short out the entire inductor. A few turns should be left unshorted on rigs other than the Viking I and II. The exact number is easily determined experimentally. On these rigs the short should be made removable in order to allow ten meter operation.) The only precaution necessary is that of watching for the correct dip (the Viking will dip at ten meters at about 90 on the pi-net scale and at about 100 for six. The six meter dip is not

nearly as pronounced as the dip on the lower bands). Tuneup on six is the same as on all other bands. Since the final is doubling, reduce the dc input a bit.

I encountered one minor difficulty that will probably vary from rig to rig. The parasitic chokes present too much reactance for six meter operation. The Viking II worked beautifully when the number of turns was halved.

Since I was still broke, and crystals cost money—in fact lots of money when one considers that they only work on one frequency—I began thinking about converting the Knight VFO. The Johnson and Heath VFO's have eleven meter coverage with six mc output which is easily converted for six meters, but the Knight lacks that feature.

Luckily, I found that the 80 meter section (fundamental at 160 meters) could easily be adjusted to oscillate all the way up to 2.25 mc. This multiplied by twenty-four is 54 mc. After a bit of recalibration the VFO tunes eighty at the low end of the scale and six at the high end. (This modification may not be necessary. The Knight VFO oscillates in the 160 meter range. The seventh harmonic falls around 12.5 mc. Theoretically, this is unusable, but my Viking II doesn't know it, so it works very well with the unmodified VFO.) Tune the first stage of the transmitter to 12.5 mc, the multiplier to 25 mc, the final to 50 mc, and you're in business.

Incidentally, I have no six meter antenna, but since the six meter band is an odd harmonic of forty meters (the seventh) my forty meter antennas function very well on six.

Considering my total investment of two and a half dollars, and only a small portion of that was used in the rig, I am forced to conclude not only that I am a genius, but that getting on six meters can be cheap, fast and easy.

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A Simple Squelch Circuit

Like the idea of a sensitive, sure squelch circuit to be added to your present receiver with a minimum of fuss and commotion?

A couple of years ago we featured a roundup of all known types, but most required some outboard circuitry. Those that didn't either had limited sensitivity, or suffered distortion on weak signals.

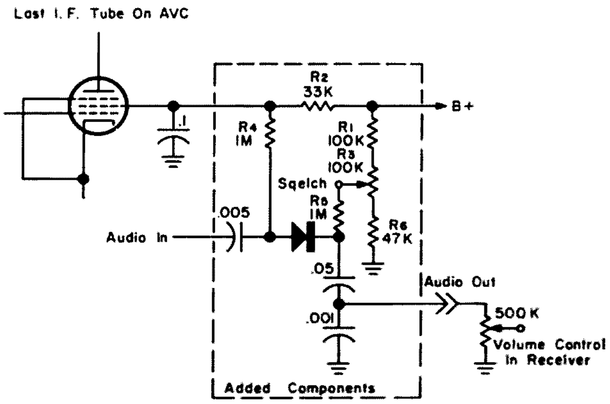
But here's a little-known one which hadn't been published at the time of the earlier article, which requires only 8 components and can be added to virtually any receiver. It's the brainchild of E. Dusina, of Hollis, N. H., and first saw print in Electronic Design magazine, an engineering-level publication with restricted circulation. We're showing it here because it's too good to be passed up.

The schematic shows how to hook it up, but what it does and how it works may not be too clear.

First let's look at the screen voltage of the *if* amplifier tube when no signal is coming in. AVC voltage is nil, which means screen current is at its highest point, so the screen voltage is fairly low. In an SP-600JX this is somewhere around 55 to 60 volts.

If "squelch" pot R3 is set so that its arm provides about 65 volts, the diode will be reverse biased because it has only 60 volts (screen level) on its anode but 65 on the cathode. Under these conditions, no signal passes through the diode. The diode appears to be a resistance of about 20 megohms, so that incoming audio goes into a voltage divider of 40/1 ratio which is equal to some 30 db attenuation. And at normal settings of the volume control, this is the same as "no signal".

Now when a signal comes in, avc voltage



is developed which applies additional grid bias to the tube. The screen current falls and screen voltage rises. When the voltage rises to 70, the diode is throughly forward-biased and its resistance drops to somewhere near 10K ohms. The voltage divider ratio then becomes 25/26, which is less than 1 db attenuation of the audio.

The two 1-megohm resistors R4 and R5 serve to isolate the audio from the screen-grid circuit while maintaining dc levels desired; they also prevent loss of audio voltage through shunting in the control network.

Note that the last *if* tube amplifies the swing of the avc voltage as well as the signal; thus the required 10-volt swing for switching of the diode is obtained with less than 2 volts swing of avc level.

By proportioning R1, R3, and R6 so that the upper and lower voltage extremes of R3 are 10 volts above and 10 volts below the extremes expected at the screen grid, the control will allow squelch to be turned off at any time, or set so that the receiver will not turn on even with strong signals. This, in turn, allows the squelch to be used to filter out interfering signals which are only slightly weaker than the desired one, even if the interference is S9 in strength.

Improved performance might result from substitution of a hand picked silicon power rectifier with extra-high back resistance (around 1000 megohms) instead of the 1N459 specified. A VTVM should be satisfactory for resistance measurement here as the operating voltage on the diode will be approximately 1 to 10 volts.

Squelch chatter can be prevented by placing the squelch after the ANL; this cannot be done with many squelch circuits since they are intimately connected with the detector circuitry. However, this circuit can be inserted between any two audio stages so long as the signal level is less than 5 volts peak-to-peak.

The circuit acts as rapidly as the avc voltage when a signal comes in, and holds on after the signal ceases only as long as the avc; for elimination of noise bursts at the end of each received signal, avc release time constants may need to be shortened.

The circuit may also be used to provide CW of constant pitch regardless of tuning. To do this, use a SPDT switch to take audio input to the squelch from either the receiver detector or from an external audio oscillator. With input from the oscillator, and with receiver avc operating, the squelch will open on each dit or dah and allow the oscillator tone to pass through to the speaker or phones. AVC time constants may need modification to avoid "tailing", but for operators who prefer constant-pitch tones the result might well be worth while.

. . . K5JKX

Souping Up The TCS Audio

Bob Harris K7CJJ/WA6UMU
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Monterey, California

The TCS transmitter has always been a rather dependable article to have around the ham shack. It can be used on the 160, 80-75, and 40 meter ham bands, plus any MARS frequency 1.5 mc and 12 mc.

The basic circuit is noted for its stability. However, the TCS would be of much more value if the modulation percentage could be boosted. By boosting the dc power to 600 volts under load, and by building a self contained 12AT7 pre-amp into the space formerly used by the crystals, the TCS was found to have a better than average AM signal upon the ham bands.

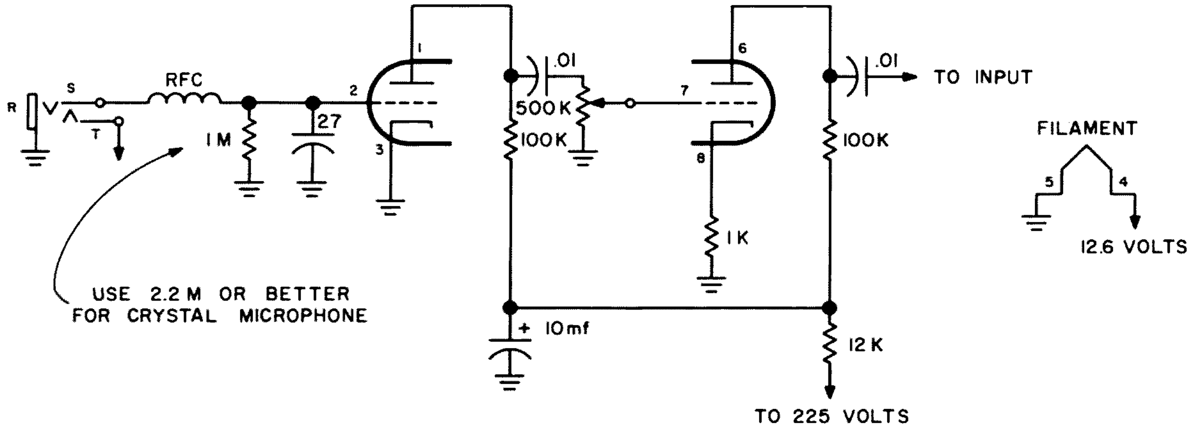
The pre-amp used is simply a straight forward circuit, and could be copied out of most of the ham publications, but the novel feature of the arrangement is found in the way the pre-amp is coupled into the existing circuit. This is simple, and is done by using the secondary of the input transformer to act as a coupling device and also act as an autotransformer to match the grids of the modulator tubes. Many eyebrows should flicker on this one, because basically it is not considered good practice, but the proof of the pudding is in the reception at the other end. Actually, there is no valid reason why this same coupling device couldn't be used in any of the surplus gear on the market that uses a carbon mike coupled into a push pull grid circuit.

Using a ceramic microphone of the tape re-

corder variety in the circuit pictured, I found that the audio power matched the carrier, and that the reception was loud and clear at the other end. The signal was so clean that the receiving station was able to pull it through very bad QRM, simply because of its clarity. Signal reports of over 5 plus from a thousand miles away on 75 meters, and over seven hundred miles away on 160 were reported. The clarity of the audio was always the outstanding feature. Using the transmitter on AM I called into SSB roundtables and most of the SSB boys didn't realize that I was on AM! They thought that I was still on the just-sold 100 V.

The only critical wiring was found to be in the input rf choke, with its bypass capacitor and input resistor. These were mounted on a terminal board by the input jack. All other components were mounted in the space normally used by the crystals. It is possible to remove the old crystal sockets, and by mounting two octal sockets for the four crystals, and the 12AT7 socket on any suitable board found in the ham shack that will fit the space, the original circuitry can be still used.

A second key jack was mounted adjacent to the mike input jack, and wired in parallel. This was found to be a very convenient way to key the relay without a push to talk mike.



The power off-on switch was removed, and the volume control was placed in this opening. The control was used, as various mikes act in various ways. If one mike is to be used continuously, this control could be replaced with a one megohm resistor. This has been done in the present TCS in use at this station, and has been found to be very satisfactory.

It should be noted that the input resistor was picked for a ceramic mike. To use a crystal mike, it is suggested that a 2.2 megohm resistor be substituted.

One word of caution is to note that the plate voltage should be taken from the relay center terminal. If the plate voltage is taken from the keyed side, there will be tails on the signal from the 10 mfd capacitor discharging.

The input to the TCS is made at terminal #3 of the transformer T101, with a .01 mfd capacitor acting as the coupling device. Make sure that shielded wire is used for all audio leads.

If the job is to be done with baling wire, there will be no need to disturb any of the TCS parts. If a crystal and 12AT7 socket board is to be installed, it will be necessary to remove the back panel to accomplish this feat. Actually the time spent was small compared to the satisfaction gained in logging the signal reports received. Go to it. Those surplus transmitters are still worth the time, if the ham wants to work them over to fill the bill. Good luck.

. . . K7CJJ

Robert Baird W7CSD
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Klamath Falls, Oregon

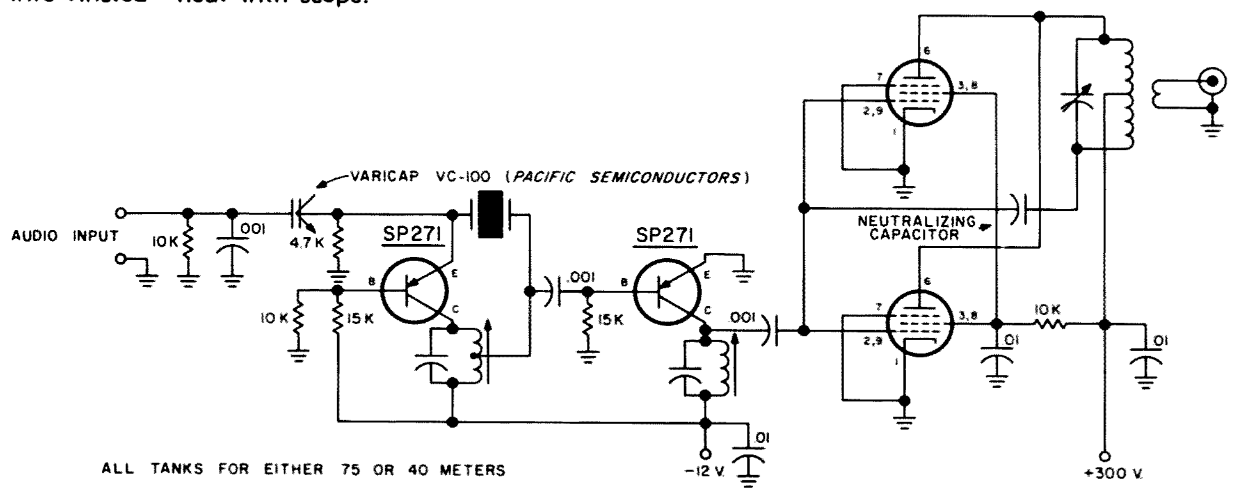
A Varicap Phase Modulator

We still receive questions about the original varicap FM modulator, published in the first issue of 73 October 1960; in fact we have made up a ditto sheet to send out because many hams don't know where they can find an Oct. 60 73. The varicap FM modulator still works as good as ever and still causes considerable wonderment to the beholders.

Unfortunately home brew mobile VFOs generally leave something to be desired as far as stability is concerned. And a lot of the mobile home brewers prefer to stick with crystal control. So herewith is a crystal controlled varicap modulator. Whether it is phase modulation as the title suggests or maybe direct FM doesn't much matter. It works and can be readily detected by slope detection and does give the added stability of a crystal oscillator. We think it has more talk power per watt drawn from the battery than AM.

The crystal oscillator will seem familiar as something like circuits found in many handbooks. We actually extracted it from a military handbook and modified it as per Fig. 1. The varicap a VC 100 made by Pacific Semiconductors gets its bias by virtue of being across the emitter resistor which runs about 4 volts. There are perhaps numerous transistors

N.C.—Two pieces of plastic covered hook up wire twisted—neut with scope.



that will work in this oscillator. We tried a 2N1195, a 2M741A and a couple other fairly high priced ones but they worked no better than a Lafayette SP271 selling for 87c. Likewise an SP271 is used in the buffer stage. The use of slug tuned circuits and fixed capacitors make for small size. The final amplifier consists of a pair of 6CL6 tubes in parallel and plate neutralized. The transistor exciter does an adequate job for these tubes and a 300 volt supply was all that we had available. If higher power is desired a single 6CL6 in an intermediate PA would be necessary. Then a pair of 6146s or something of that size could be put in the final.

No audio is shown in the circuit diagram because we still have the varicap driver from the original February 61 73. There would be room on the chassis illustrated to put in a two stage transistor amplifier if desired. Possibly a *sound powered* telephone type mike might do the job alone. Our experimentation with this little rig was quite successful. One word of warning—it works fine on a storage battery but if you use a lightly filtered rectified ac supply it is pretty rough. We thought we had a real lemon until we connected on 12 volts of honest to goodness DC.

One very important discovery was made—a back biased epoxy or top hat silicon rectifier worth 30c will work almost as good as an expensive varicap. A little more audio voltage may be necessary. The Q is no doubt lower but the effect as far as operation is about the same.

. . . W7CSD

Hi Hi

The Friendly Silicon Rectifier

Fred Haines W2RWJ
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Liverpool, N. Y.

Since the advent of the high voltage silicon power rectifier several years ago, it seems to have gained an unenviable reputation as an undependable, on again-off again, no account component, not worth taking a chance with in the ham shack. In the meantime however, the semiconductor boys have been trying hard to figure out just what seems to be the trouble in applying silicons in practical power supply circuits. You know the story. . . . "Throw away those old outmoded antique 866's and replace them and their big power-mad filament transformers with these new small cool efficient marvels of modern technology." Well, many of us did just that, but ended up holding the bag. The reason, we now know, was that we didn't realize some of the finer nuances of the care and feeding of these beasties. We weren't to blame though. . . . It's a fact that even the semiconductor manufacturers didn't know enough to publish any helpful literature. Now they do, and we should forgive them and make a new try with this truly amazing little rectifier.

The first trouble to cause the early demise of a silicon rectifier is a filter circuit with a capacitor input. When power is first applied to the circuit, the capacitor charging current is great enough to destroy the rectifier on the first half cycle or so of the very first sine wave. Poof! There goes $1.20! Good grief.

Fig. 1 shows the path of the destructive charging current. The remedy is simple, and has but one drawback as we shall see. Merely place a current limiting resistor in series with the diode, and the current during the initial charging period of the filter capacitor cannot exceed that specified as maximum by the diode manufacturer. Note that this negates one of the advantages of the silicon rectifier: low forward drop and, thus, better power supply regulation. This isn't too serious though, because with a capacitor input filter, the advantage of low forward drop doesn't contribute very much to regulation. The big thing is, we *have* eliminated the hot old rectifier tube and its transformer winding. In my experience, this circuit will operate practically forever without a burned out diode. See Fig. 2.

To figure out a rule of thumb for calculating the series resistance required, we could reason in a sloppy way as follows. . . . The manufacturer usually specifies the "peak one cycle surge current" for a rectifier. To be safe we should assume that no current greater than ½ of the maximum value should ever pass through the diode. When power is first applied to the power supply, the diode must supply the charging current for the input filter capacitor, which we can assume is an instantaneous short circuit. Thus in Fig. 1 the only thing to limit the current flow is the forward resistance of the diode; usually of the order of a few tenths of an ohm. For example, let's assume that the diode in use has a maximum surge current rating 20 amperes. We wish to limit this to no more than 10 for safety's sake. If the *Peak*

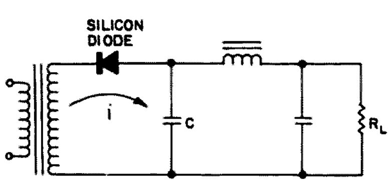


Fig. 1

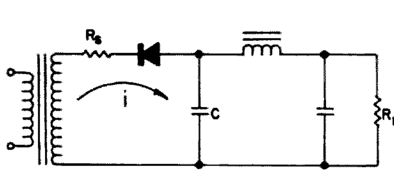


Fig. 2

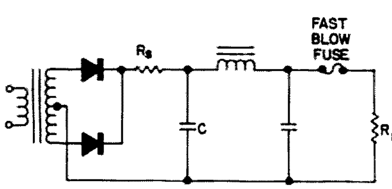


Fig. 3

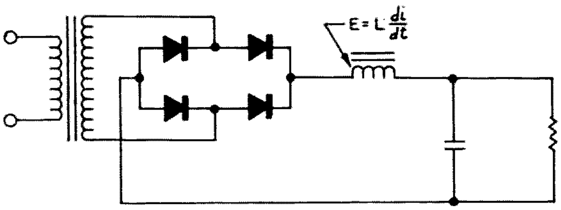


Fig. 4

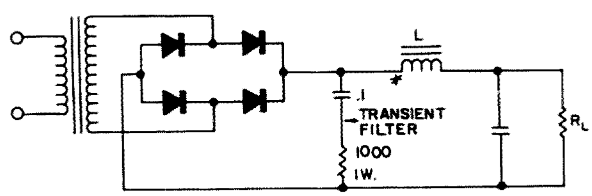


Fig. 5

* Voltage rating must be 1.5 times or more dc voltage at this point.
750 vdc, 300 ma supply

voltage of the transformer secondary is 10 volts, then a resistor in series with the diode of 1 ohm will do the trick. $R = \frac{E}{I} = \frac{10}{10} = 1$. We have assumed here that the transformer secondary has no ohmic resistance, which of course is not true. If the transformer measures 1 ohm or more, you may get away without the series resistance in some cases, but since the transformer secondary resistance is mixed up with some inductance too, it may be safer to ignore it and rely upon a separate resistor. It's better to err on the good side. The simple procedure outlined here can be adapted to any capacitor input filter with a silicon rectifier.

$L\frac{di}{dt}$! Well . . . what's that, you may ask if you aren't an expert with the calculus. It amounts to a large voltage being developed across an inductance if a large, rapidly changing current flows through it. In the case of the choke input filter shown in Fig. 4, a large voltage transient is developed across the filter choke when the power is first applied to the supply. That transient can reach terrific peaks; as much as a thousand volts not being uncommon!

A good precaution against rectifier popping in this case is an RC time constant filter as

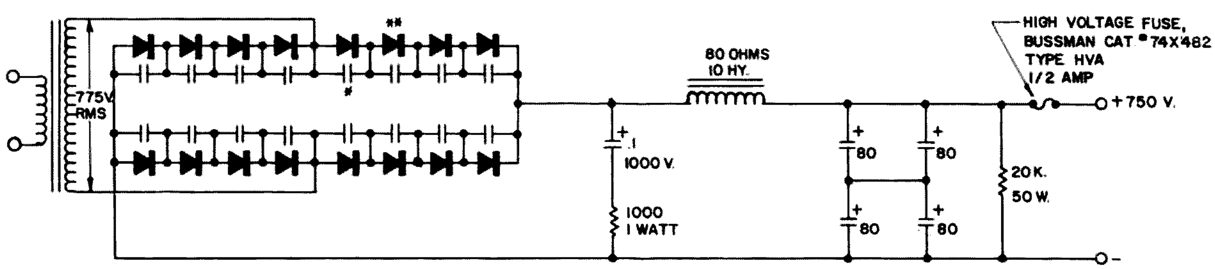


Fig. 6

* All .01, 600 volt rating. ** All G-E Co. 1N1695 silicon diodes. All filters are 450 volt units.

The second trouble to cause the fast death of silicons is improper or no overload protection. The best inexpensive protection is the fast-blow fuse wired in after the filter, as shown in Fig. 3. Supplies with such a fuse have been shorted out with screwdrivers purposely as many as 100 times without any trouble that 100 new fuses couldn't remedy. If the circuit supplied by the power supply has a large capacitor across the dc supply line, the fuse may blow whenever the circuit is energized. In this case, put the fuse in the device to be operated by the power supply *after* the large by-pass capacitor.

The third trouble to be considered in our silicon rectifier health program is called

shown in Fig. 5 connected from the junction of the rectifiers and the filter choke to ground. Many diodes have been saved by this simple circuit. A series resistor is not required in the case of a choke input filter, since the filter choke has a high enough ohmic resistance to limit the peak one cycle current through the diode or diodes to far less than the rating.

Fig. 6 illustrates a 700 volt supply of conservative design using silicon rectifier diodes. The supply has been in use for a couple of years at W2RWJ and the original diodes are still in service. Notice the surge by-pass capacitors across the diodes. These should always be employed whenever diodes are connected in series to prevent transient damage.

For best results, select diodes of the hermetically sealed variety to insure long life. The General Electric 1N1695 and the RCA 1N3195 are good examples of high quality sealed units at moderate price.

. . . W2RWJ

IoAR News

The Founding Membership of the Institute of Amateur Radio is now almost 600! The ten dollars dues is a lot of money and represented a hardship to many of the Founding Members, but the tremendous importance to amateur radio of this money at this time overshadowed personal problems.

Harry Longerich W2GQY/4 reports that supplies and an Institute flag are available to members who would like to represent the Institute at hamfests and conventions. Please write to Harry at the Institute of Amateur Radio, 5219 Seventh Road, South Arlington, Virginia. He has information booklets, IoAR buttons, the flag and application blanks.

Founding Members all should have received, in addition to their large golden membership certificates and gold plastic membership cards, a copy of the FCC Part 97, the amateur radio rules and regulations. These are sometimes hard to find (and expensive to buy from the government) when you need them so the Institute has printed them up and distributed a copy to all Founding Members. A copy of the recent FCC release on the new Citizens Band regulations and the new RTTY identification rules has also been sent to each Founding Member. The first 400 Founding Members, whose calls were published in the July issue of 73, apparently have been given a free subscription to the *W. Amateur Radio News*, for which I suspect we can thank the ARRL.

The Institute held off sending newsletters to Congress during the K3UIG convention, but resumed them when everyone had returned to Washington.

News is a little scarce during the summer, what with vacations and all.

Wayne Green W2NSD/1

Moonbouncing in Switzerland

Dear OM Editor:

I am very glad to give you some details of our Moon-Bounce activity here in Switzerland.

The Crew consists of 5 Hams which are: HB9RG Hans, DL9GU Ed, DJ4AU Jurgen, HB9RF Johnny, and DJ3EN Kurt.

The successful MB-QSO East- to Westcoast of USA back in 1960 encouraged us to jump into this new field of Amateur-Radio.

In 1961 we got a 10 foot dish from the German Post-Administration. The big difficulty now was: How to get it free of duty over to Switzerland. (Unfortunately tariff of duty depends on weight in Switzerland).

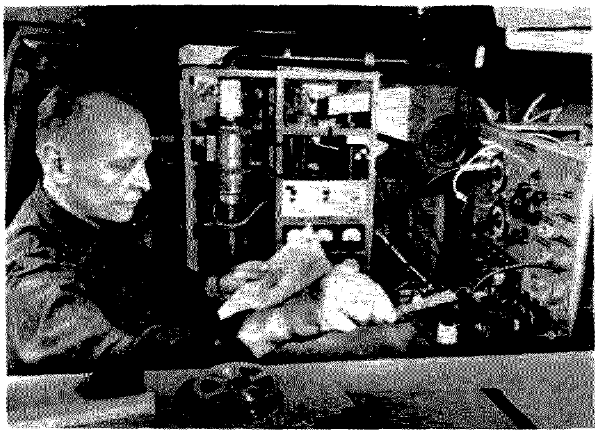
Immediately we constructed a polar mount and in the same winter we began also to build up all the necessary parts, a paramp for our converter and a new final amplifier.

After a hard series of tests, problem number one was the tracking-system. We were able to ask Sam Harris, W1BU, to send us some signals. This first test was negative. Some minor modifications on the parametric amplifier and the dish brought us our first success. On the 22nd April, 1962 we received our echo from the Moon. Since then we tried again with W1BU, but never got the signals through.

In spring 1963 we enlarged the dish to 17 feet and replaced the RG-17 coax by ⅞ inch Heliax. Our only partner in 1963 was the sun. New Varactors in the paramp brought us more stability on the receiver side.

In our latest test in spring 1964 we managed to hear the sun just over the receiver noise with the converter alone. Connecting the paramp ahead improved the reading by 6 db.

Our station for 1296 mc: The heart of the transmitter is a transistorized oscillator, 7 feet under ground in my garden, well isolated to keep a steady temperature. The crystal is 8 mc and it can be moved to the exact frequency by a varactor. On 24 we compare the accuracy of our frequency by an oscilloscope with Droitwich (Broadcast station on 200 kc in England). Conventional multiplier stages are used to 144 mc. From there cavities with 3CX100A5 bring the signal to 1296 mc. Two paralleled



HB9RG

HB9RF & HB9RG putting 432 dipole in.

cavities with 3CX100A5 work as driver stages with an output in the order of 100 watts. The final output is an RCA 7650 with indicated power of 400 watts. Power and SWR are permanently watched in a Micro-Match coupler. A dipole with reflector is the feed of our system. 18 feet of nitrogen pressurized Heliax link the rig with the antenna. On the receiver side we use a parametric amplifier constructed after details given in QST Jan 1961. For the moment the varactor is a Microwave 4294, pumped at 9 kmc with a 2K25. A mixer 1N21F brings us the signal to the first if of 144 mc. Behind that comes a two meter converter to 28 mc which finally is followed by a Collins R-390A.

For the test with KP4BPZ on 432 mc we used: The same antenna with adapted dipoles. 32S3, 62S1 followed by cavity tripler and driver with 3CX100A5. The same final cavity as on 1296, where it works on ¾ Lambda, we have been lucky to get it working on ¼ Lambda on 432 mc.

The receiver was a normal converter with 7 db noise figure. In lack of time (we have been informed only 10 days before the test) we were not able to build a letter adapted station.

On the 13th June, 1964 at 1842 GMT we heard the first CQ of KP4BPZ. In peaks the signal was 15 db over the noise level. KP4BPZ was logged and recorded in contact with: W1BU RST 589; W9GAB 469; HB9RG 579; W9HGE 459; W1FZJ SSB and G3LTF.

I think it is not necessary to tell you how happy we were to be the first Europeans working 70 cm over the ocean. Our QSO seems to beat the world-record on 432 mc.

We noticed that Moon Bouncers in USA are much more interested in 70 cm EME-work and we intend to improve our system by a parametric Amplifier.

Inclosed you will find some pictures and we hope that this story in my poor English will be a help for you to show to your readers how Moon Bouncers in Europe are working.

HB9RF "Johnny"
HB9RG "Hans"
P.O. Box 114,
Zurich 33, Switzerland

The Heath SB-400

William J. Hall K1RPB
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N. Wilbraham, Mass.

Last year it became my misfortune to sell a well stocked ham station in order to purchase a new home. This turned out to be a blessing in disguise, since it gave me a chance to become reaquainted with the family, get a lot of house fixing done and play a few rounds of golf to boot. This spring, the financial picture was again being painted black, the family had seen enough of me and my golf score wasn't improving much. It was time!

I had been keeping a close eye on the rapid development of new equipment being offered on the amater market. There were single and multiple band transceivers, high and low powered transmitters etc., etc. One thing was sure. It had to be SSB and definitely offer provisions for good ol' CW. It seemed like a tough decision, but Benton Harbor had again come up with something which offered the highest ratio of performance to price. I therefore took the plunge and ordered the new "SB" line and waited impatiently for the goodies to arrive.

Construction

After a somewhat lengthy wait (or so it seemed) the SB-400 finally arrived. I locked the ham-shack door and eagerly began to piece it together. The kit was completed in slightly less than 50 hours.

Construction was simplified considerably through the use of two circuit and two terminal boards. The instruction book was apparently well planned, minimizing difficulty in placing the tightly packed components. Heath even supplied the solder. The finished product, which bears a faint resemblance to a high priced Brand X was plugged in and worked right off the bat. Alignment was completed in approximately ½ hour and required only the use of a VTVM and rf probe. I did have a little difficulty in producing sufficient drive near 28.5 mc but resolved this by tightly dressing down all of the coil leads in the grid and plate circuits of the 6CL6 driver.

Circuit Description

The transmitter design can be broken down into four separate systems, an exciter, a vfo, a heterodyne oscillator and an amplifying stage. First, the LSB, CW, and USB signals are produced at 3393.4, 3395.4 and 3396.4 kc. This is mixed with the variable frequency oscillator (LMO) which operates between 5 and 5.5 mc. Using a little arithmetic we find a mixer product varying between 8.395 and 8.895 mc. This in turn is mixed with a signal from another crystal controlled oscillator to produce the desired transmitting frequency. The signal is finally amplified through a 6CL6 driving a pair of AB_1 6146s. We end up with full 80-10 meter coverage, (all crystals supplied, gentlemen) with approximately 100 watts output.

The circuit design also features such important items as an automatic level control (ALC) system. This allows a higher level of talk power without risking attendant flat-topping and distortion. It increases one's signal effectiveness considerably. In addition, an audible sidetone is generated in the CW function to allow for self monitoring. This also trips the VOX system allowing for semi-break-in keying. In the SSB position, one has the choice of push to talk or straight VOX operation. The antenna changeover relay is built in, although provisions for an external changeover are there for those who prefer it. The power supply makes good use of tiny semiconductor rectifiers. Separate medium and high voltage windings eliminate the need for power robbing dropping resistors and voltage regulators on the 6146 screens.

Operating Performance

After using the rig for a little while, one gets used to it and wonders "what else can they possibly come out with?". I have used the SB-400 with a Drake 2B and more recently, the companion SB-300 receiver. The transmitter is a dead mirror image of the latter. I have operated it in both the transceive and separate transmit/receive functions. All one has to do is change a couple of cables, which takes no

time at all and adds great versatility to the line. Tuneup amounts to resonating the driver and final and choosing the desired mode. The CW signal is removed one kc from the USB frequency. Therefore, in the transceive position, one tunes in the desired CW note at 1 kc, which centers it in the receiver 400 cycle band pass. This places the transmitter on dead zero beat. The meter is switchable between grid and plate current, plate voltage and relative power output.

Reports on distortion, signal width and sideband and carrier suppression have been excellent. There is no frequency drift that I have been able to detect, even from a cold start. My own scope measurements have confirmed the very fine comments on signal quality. To sum it up, gang, it would be mighty tough to beat this deal at twice the price of $325.

Letter

Dear Wayne:

For these past eleven months I've been reading and quietly checking your efforts on behalf of the General licensees, and your healthy opposition to the QRM from QST headquarters. Your July appraisal of your efforts seemed to reflect a sense of discouragement and defensive thinking. I hope I read this incorrectly, Wayne. Perhaps the amateur body has not responded as readily and as freely as you had anticipated. Many are more than ready to give lip service, Wayne, but cash is another matter. It's pretty hard, in a lot of cases, to let go of the ten bucks for the IoAR, or even for shoes for the kids, for that matter. There seem to be many hams who just aren't in a position to send ten dollars. Would it be wise to appeal for lesser amounts? My membership in the ARRL expired on January 1 this year, and I did not renew it on the grounds that I did not want the crew at the ARRL to interpret my renewal and subscription to QST as a "yes" vote on all the crackpot or insane proposals they could dream up, and appealed to them to instill a bit of democracy in the organization by submitting serious questions to a vote of membership. I got the standard reply of "If a republican form of government is good enough for America, it is good enough for the ARRL." Perhaps I'm wrong, and you're wrong, and those who take the position we have taken are wrong, but I cannot help but wonder. The ego that makes for disregard of the opinions of the membership of a group can only lead to revolution by the members, and the ARRL does not have the means of control to suppress an uprising. I should say also, that not all hams are members, and not all hams care. To many hams, the final disposition of the ham bands is not of great importance. Ham radio is still a hobby, as it should be, and not a way of life. I'm afraid to continue, Wayne, to write in this vein, as it only leads to a reflection on injustice as it seems to be practiced by the government of the ARRL. The upshot of all this writing is that, enclosed, find two checks: one for the renewal of 73, and the other for my IoAR membership. I was going to send you money for the QST magazine too, but I'm still mad at them, but leaning toward rejoining so I can vote against the director, although what good that would do, I'm at all sure.

At any rate, Wayne, I am only one of many who hope you can be successful in your fight for justice—justice without discrimination for or against any amateur.

Richard C. Mack, KØIVD

Save Ten?

Paul Franson WA4HWH
Wayne Green W2NSD

During these long days of the quiet sun our poor old ten meter band will be, for the most part, a mighty dead place. A lack of activity on any band is bad news for us, and one like ten is particularly bad because it is so desirable to others. Perhaps we can do something to bring it back to life.

With the release of the new CB regulations there is likely to be quite a number of CB rigs floating around. Why not put these to work on ten meters? This would not only provide a good use for presently unused CB rigs, but would do a lot toward sparking activity on ten.

I propose a national calling frequency of 28.600 mc. Let's call this Channel A. I propose working channels of 28.65 and 28.7 mc, Channels B & C. Most CB rigs will cover these frequencies with just a little retuning. Those with continuous tuning receivers can be retuned simply. Crystal controlled receivers aren't much more of a problem.

I've written to all CB manufacturers telling them of my plan. Many answered and these are listed here along with any important comments or suggestions that they may have made.

Many of the CB sets can be souped up to 10 more watts. I'll be interested in any ideas that can be passed along on this. Also, if anyone has any particular trouble and conquers it, I am sure that all other owners of that type set would want to know what to do.

Since all of the CB rigs are crystal controlled, there is the problem of crystals. Fortunately at least two of the crystal companies are willing to go along with our plan and have agreed to make crystals available for Channels A, B, and C. Texas Crystals will send you a crystal for any of these channels for $2.95 postpaid. Be sure to specify what model and make of rig it is for. Write to Texas Crystals, 1001 Crystal Drive, Fort Myers, Florida. International Crystals will supply their .01% tolerance crystals out of stock for $4.40 for the fundamental type crystals and $3.30 for the overtone type. You'll have to check and see which type your rig uses. If the frequency stamped on the top of the crystals is in the 8-14 mc range you can be reasonably sure that it uses fundamental crystals. Write to International Crystal, 18 North Lee, Oklahoma City, Oklahoma.

Since Channels A and C are on even 100 kc points there should be little problem in getting everyone adjusted right on the channels. The crystals can be padded onto frequency when you find someone with a 100 kc standard.

Since FCC is cracking down on the CB hobbyists we may shortly have an influx of two things into our hobby: used CB gear at bargain prices and used CB'ers trying to become hams. Both *can* help amateur radio. Proper instruction from old hams in the art and attitudes of amateur radio can help produce new hams who are neither ignorant nor indifferent lids. Help them become hams and you can shape their interests and actions. Ignore them and they will get their tickets anyway, but we may be treated to "10-4's" on six meters.

No matter how the CB'ers turn out, we

should receive a boon in equipment. Most CB transceivers are well built, well designed and modern. (They should be. For the past few years, manufacturers who used to concentrate on ham equipment have been chasing the pot of green at the bottom of the CB rainbow.) Most CB transceivers can be easily adapted to ham use on 10 meters. They can provide a cheap reliable source of equipment for local rag chewing, mobile use and emergency nets. Many of the rigs are crystal controlled in receive (all are in transmit, of course). This may seem a handicap at first, but it is an advantage for the applications described above. Virtually all CB rigs include squelch so you can leave the receiver on with the squelch turned down. If anyone comes on, you're already on frequency so there's little possibility of missing them. Obviously, everyone must monitor the same frequency to make this work. We suggest 28.6 mc (channel A) as the primary frequency for monitoring. This frequency is low enough so that most CB rigs will reach it with no trouble. In many areas more frequencies will be needed. 28.65 (B), 28.7 (C) would make good secondary channels.

There is a temptation to go farther up the band, but these three channels should provide enough frequencies for a starter. In addition, they are spread out over only 100 kc. The CB band is 290 kc wide, so you should be able to jump from channel to channel without touching the internal adjustments. However, make sure that the receiver is left on channel A for monitoring when the rig is not in use. When you want to make a contact, you can call on A, than switch to another channel if desired.

Use of these CB transceivers should provide us with a little more activity on 10 meters and help keep down the QRM on 75. There is usually nothing to the modifications necessary to get on 10. For crystal controlled receivers, new crystals and a slight retuning is all that should be necessary. It might be necessary to remove a turn of wire or reduce a capacitor in some cases. It may even be possible to make the receiver tune continuously by plugging a tuned circuit in a receiver crystal socket. Tunable receivers will require a little juggling of adjustments in the front end. Transmitters are even easier to adjust. Plug in a new crystal, retune the final and you should be in business.

If you are interested in this we might just bring activity back to ten meters, provide considerable activity for clubs, and make mobiling around the country a lot more fun. How about it? Will we be seeing you on Channel A?

(Turn page)

(Save $10 continued)

The following manufacturers have indicated that their equipment will operate on 28.6 mc. Unless otherwise indicated, the only changes required are new crystals and retuning of the coils in the rf stages of the transmitter and receiver.

Browning Labs R-27 Receiver. Replace first osc. crystal with a 33 mc 3rd overtone crystal.
S-23 Transmitter. Use 3rd overtone 28.6 mc miniature wire-in crystal. Drake M-506. Use 6235 kc crystal.
Drake M-523. Use 23.960 3rd overtone wire-in and 24.415 mc fundamental.

e.c.i. Fleet Courier.

General Radiotelephone Company MC6. Receive crystal is 28.6 mc minus 452.1 kc in 3rd overtone. Transmit crystal is 14.3 mc fundamental.

Hallicrafters CB-3A, CB-5 and CB-7. CR-23U crystals. Transmitter is 28.6 mc. Receiver is 28.6 mc plus the if of the unit. Hallicrafters makes a kit to make the CB-3A or CB-7 receiver tunable.

Hallmark Instruments Model 512.

Heath Company All models. Transmitter uses 3 rd overtone crystal. Receive crystal is 455 kc higher.

Maxwell Electronics Radiocom transceivers. Transmit frequency is 28.6 mc. Receive frequency is 455 kc above 28.6 mc.

Polytronics Labs PC "N". Polycom also makes a 10 meter version for CD use. They sell a continuous tuning attachment for receive, the Poly Tuner.

Radio Electronics Designs Model 10/2. Transmit crystal is 28.6 mc divided by three. Receive crystal is third overtone 455 kc below 28.6 mc.

Tram Electronics Receive: Replace 31.5 mc crystal with 33.3 mc parallel resonant 3rd overtone crystal. Use a 4700 kc crystal in receive socket. Transmit crystal is 14.3 mc.

Utica Communications MC 27. Transmit crystal is 3rd overtone. Receive crystal is 1680 kc above 28.6 mc.

Vanguard Electronics Labs Mark 1 and Mark 2.

Vocaline Company Model ED-278.

Webster Manufacturing Company Models 440 and 412.

SB 10 and the ARC-2

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Recently there has been quite a bit of activity over the ARC2 Transceiver. I have one more to add to the ARC2 field.

The conversion of the ARC2 is for SSB use as well as AM and CW. The conversion is not difficult and should not take more than a few hours.

The conversion consists of biasing the final stage to class AB1, breaking the drive lead to the grids of the final, installing two BNC coax connectors for the drive leads, and grounding the output of the receiver during transmit periods to prevent feed back and VOX lock up.

The change of operation from AM, SSB, CW or Cal, is controlled by the function switch. The old position marked MCW now performs the side band functions in conjunction with some of the existing relays with slight wiring modifications.

1. Rear section of MOD PA compartment: At the rear panel next to the rear modulator tube mount two BNC type coax connectors. These connectors will be used for a break in the drive, where the SB10 will be tied in, or a short piece of RG58 with appropriate connectors for class C operation for phone or CW use.

   Mount these connectors near the base of the tube, be sure they clear the snap lock for the tube.

   Drill a ⅜ inch hole between the modulator tubes for the coax leads from the BNC connectors. Be sure not to drill through the existing wiring on the bottom side of this section.

   Drill another ⅜ inch hole between the PA tubes, this hole will accomodate the wiring for the bias switching for the PA tubes.

   Make a small mounting bracket for a pair of OB2 regulator tubes and mount it in front of the front generator bracket.

   Make a wooden mounting plate for a 22½ volt battery. The mount will fit into the front generator bracket and be secured by the tightening screw on the bracket. Ground the positive end of the battery, negative is bias.

2. At relay K107, AM-MCW relay location:
   a) Remove wire No. 26A2 from No. 2 of relay. Remove wire No. 63A1 from No. 1 of relay. Tie these two wires, No. 26A2 and 63A1 together, solder, tape, and tuck

them into the harness.

Remove wire No. 25A1 from No. 3 tape and tuck this wire into the harness.

Disconnect wire No. 83A1 from No. 4, and wire No. 16A1 with No. 16A2 from No. 5.

a) Tie Nos. 25A1, 83A1 and 16A2 together solder, tape, and tuck them into the harness.

b) Run a wire from No. 1 of the relay to ground. Run a wire from No. 2 to the ground end of the bias resistor, R108, a 15K in the final compartment near the front. Remove the ground strap from the ground end of R108.

Run a wire from No. 3 of the relay into the generator compartment for the bias supply, tie it to the negative 22½V. The above changes modify K107, to AM, SSB mode selection under control of the function switch S115, a real dog to get to. One modification must be made on this switch.

3. Run a wire from the anode end of the VR tube string to R109. Tie the wire to the end of R109 farthest from the rear of the chassis, the end near the feed through insulator for the plate of V122 the rear modulator tube.

Run a wire from the cathode end of the VR string to No. 5 of K107, and a ground to No. 6. This connects the regular tubes in the screen grid circuit for linear operation.

4. At K105 keying and receiver disabling relay: On No. 8, wire No. 29A1, disconnect and tape this wire back.

Run a wire from No. 8, the side of the relay coil that is to be keyed, to K102. K102 is the second relay from the front right chassis near the top. Run the wire to the coil contact that is easiest to reach. K105 relay operation will ground the output of the receiver during transmit.

Remove wires No. 27A1, 27A2 and 15A2 from 4 and 5 of K105. Tie these wires together solder, tape and tuck them behind the relay coil. These wires provide the keying path from the key and mike jacks.

At S115 the functions switch: Section "A" of this switch, section nearest the front panel, No. 9 is strapped to No. 10. Strap No. 8 to No. 9. This will turn on the bfo in SSB function position.

5. Grid Drive for Final: In the compartment under the rf tubes disconnect the coax from pin No. 5 of V104, and run it through the hole previously drilled to one of the BNC connectors.
   From the other BNC connector run a short piece of RG58 back to where you disconnected the above mentioned drive lead.
6. All that is left is to plug the SB10 to the in and out jacks turn on the power and; side band with the ARC2.

Now if someone can tell me how to clean up the selectivity of the ARC2 without adding an external appendage, something that will track the tuning I'll feel my time wasn't wasted. The thing that makes it difficult is the variable *if* that is tuned from 1 to 1.5 Mc throughout each band.

Next project for the ARC2 is how to key the P.T.O. for NBFM and RTTY, that is to do it and maintain the stability.

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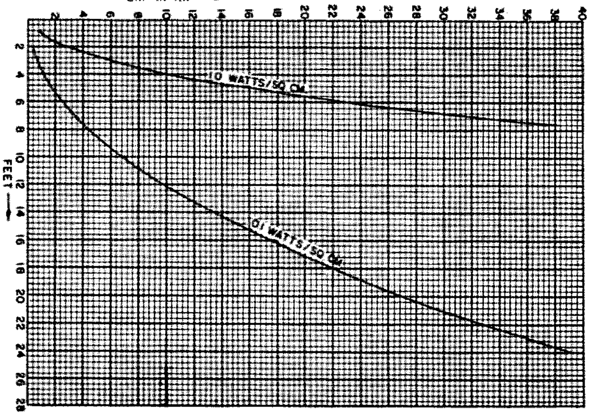
RF Hazard

With the possibility that one kilowatt stations may soon make their first appearance on the amateur band 420-450 mc it may be timely to consider the often discussed hazard of radio frequency radiation on the UHF bands. Although this subject has been given considerable study by companies engaged in UHF communications, comparatively little has been learned as to how much radio radiation actually constitutes a hazard. We are reminded however, that a hazard does exist by frequent news of injury to technicians working with high power radar transmitters.

Nor is this hazard restricted to the microwave range. A rather recent study conducted by Dr. Pearce Bailey of the National Institute of Health indicates that over ten monkeys have been killed from less than five minutes exposure to relatively low power radiation in the range 380-390 mc. Radiation is measured (in this case) in watts/ sq cm with the following levels generally considered as reference values.



Distance of dangerous rf fields as a function of ERP.

0.01 watt/ sq cm is representative of the radiation level in a typical radar room. It is considered a safe value for day-to-day exposure. This value is equivalent to 60 volts/ meter.

0.1 watt/ sq cm is considered safe for only limited exposures of a few hours. It is equivalent to 190 volts/meter. At this level the blood does not provide adequate cooling for the heat created by the radiation. This level must be regarded as dangerous.

1.0 watt/ sq cm is an extremely dangerous level of radiation for all but momentary exposures. This is equivalent to 600 volts/meter. Extended exposure will very likely cause brain damage at UHF.

Now let's consider some of the cases that may occur at amateur stations operating in the band 420-450 mc if the FCC grants final approval to the 1 kw power limit on this band. An example of the maximum power station on 420 mc is the case of a transmitter *delivering* 500 watts to a stacked array with a gain of 19 db. This works out to be an antenna gain of 79. (Antenna gain = anti log of db gain/10). To find the effective radiated power (ERP) we multiply the power input to the antenna

by the gain which results in 39,500 watts ERP for this station in the forward direction of the beam. The problem now is to calculate at what distances the values of 0.01, 0.1, and 1.0 watt/ sq cm will occur from an antenna radiating 39,500 watts ERP. For this, a handy formula has been derived which can be summarized as follows:

0.01 watt/sq cm occurs at (12.1 times the square root of the ERP in kw) feet.

0.1 watt/sq cm occurs at (3.82 times the square root of the ERP in kw) feet.

1.0 watt/sq cm occurs at (1.21 times the square root of the ERP in kw) feet.

Substituting our value of 39.5 kw ERP we find that 0.01, 0.1, and 1.0 watts/sq cm will occur at 76.0, 24.0, and 7.6 feet respectively. From the foregoing it can be concluded that working near a beam delivering 39.5 kw ERP can be quite dangerous. If beam adjustments are being made from a rooftop or from a tower, it is therefore advisable that the adjuster retire to ground level when the transmitter is energized.

Now let's consider a more typical case of the serious 420 mc operator who only runs medium power. This would be in the range of 3,700 watts ERP. Such power would be radiated by a transmitter delivering 150 watts to a 8 over 8 stacked array with a 14 db gain. In this case, the danger levels of 0.1 and 1.0 watts/sq cm exist at 7.41 and 2.35 feet respectively from the front of the beam. Still powerful enough to keep your distance when the transmitter is energized.

Finally we consider the case of the low power station. This station delivers 25 watts to an antenna with 11 db gain. This results in 315 watts ERP. The 0.1 and 1 watt/sq cm fields appear respectively at 2.14 and .678 feet from the forward direction of the antenna. Even at this level it is best to back off the antenna when power is applied.

When working with these reference levels of radiation we should consider two important factors. The first is that our calculated values apply only to the forward beam direction in the same plane as the boom of the beam. In any other direction the radiation will naturally be reduced. Our second consideration is the very high attenuation of UHF signals by obstacles. For example, a brick wall will reduce a UHF signal at least 10 db and this would probably reduce the radiation to a safe level with any power level the amateur would encounter. This should relax those who might be concerned about radiation entering a house in the path of the antenna beam.

It should be realized that although the

values given for radiation at a distance are quite accurate, the effects they produce on the human body are in part dependent on frequency and can not be stated to any large degree of precision. At higher frequencies than 420 mc these effects are much more serious. At lower frequencies the radiation is not nearly as dangerous. When high gain antennas are used it should also be understood that even low power can produce a high ERP.

Because of the many "unknowns" which still exist in this field, the amateur should always be careful when working with UHF radiation and allow a generous safety margin.

. . . W2QCI

References

The American Radio Relay League, The A.R.R.L. Antenna Book, West Hartford, 1955.

Gihring, H. E., "Antennas for Television Broadcast" in the NAB Engineering Handbook, ed. by A. Prose Walker, New York, 1960.

How to Raise a Beam

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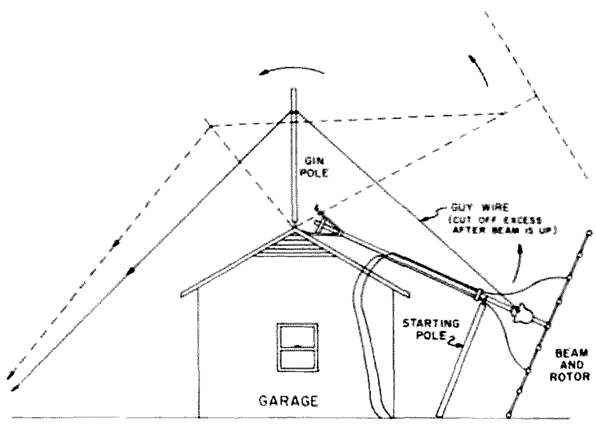


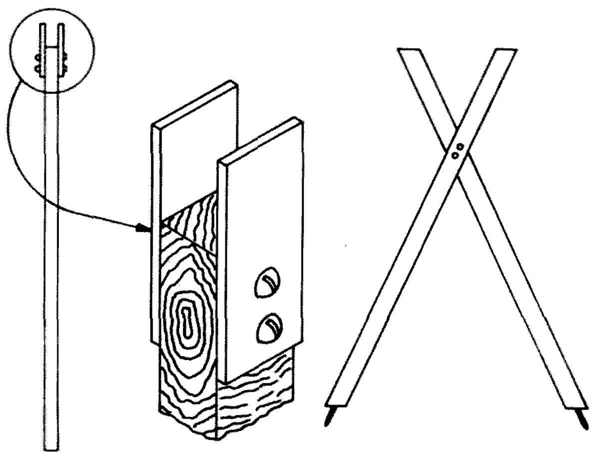
The antenna base is a TV antenna tripod about two feet tall. Bolt two hinged feet to roof first, then third. The dotted lines illustrate the path of the antenna as it is raised. The starting pole is used to lift the antenna above the horizontal, after which two men on the wire can raise the beam.

After purchasing a combination six and two meter Yagi last fall with a rotator and assembling it on the ground, it occurred to us that some difficulty might be encountered in raising it up on the roof and placing it on top of a 20 foot pole. A trip to the top of the 15 foot garage roof confirmed the suspicion. The old legs and also the confidence went to pot at this modest height, the back yard sure looked far away.

With blind determination however, we forged ahead and placed the assembled beam, rotor, guy wires, and 20 foot pole in the driveway. All connections to the feed lines were made tight and sprayed with lacquer and the guy wire eye bolts were screwed into the house at the proper points. The bottom of the pole was handed up to me on the roof by the XYL and the plan was to bolt it into the tripod base on the roof and swing it skyward. Ha! It was impossible! The assembly wouldn't budge an inch.

The VHF fever was biting pretty hard though and a way would be found somehow. The accompanying diagrams illustrate the solution I worked out. Once up, the beam was over forty feet above the average surrounding terrain, and this height has been the biggest factor in the excellent 2 meter results I have had at W2RWJ. Others in the vicinity with higher power and lower beam height have not worked out as well. The effort was well worth expending.

. . . W2RWJ



Starting pole: 2 x 2 fir, 12 feet long with two mending plates bolted at top.
Gin pole: 2 x 2 fir, 8 feet long nailed together as shown. Note spikes made from headless nails inserted in drilled holes. These pierce roof shingles to provide firm footing. Patch roof later with two dabs of roofing cement.

Citizens Radio Rules Tightened

After considering the more than 2,500 comments filed in Docket 14843, and other related information before it, the Commission adopted a Report and Order amending Part 95 (formerly Part 19) of its rules governing the Citizens Radio Service, effective Nov. 1. A major purpose of the rule changes is to clarify the permissible and prohibited communications and uses of citizens radio stations. The rule changes relate principally to operations of Class D stations in this service.

The Citizens Radio Service is designed to provide useful short-distance radiocommunication to meet the business and personal needs of a large segment of the public. The desirability of permitting hobby-type operation has been given particular consideration and earlier determination that the public interest would not be served by permitting such activity has been reaffirmed. Licensees are specifically prohibited from engaging in radiocommunications as a hobby or diversion; that is, operating the radio station as an activity in and of itself.

The Commission notes that the trend on the part of many Class D citizens licensees to use their stations for hobby-type operations has grown to the extent that the utility of the service for its original purposes has been substantially impaired. While anticipating that the rule amendments will assist the conscientious licensee to operaate in acordance with the spirit and intent of the rules and thereby lessen enforcement problems, the Commission warns that if there is a continued misuse of operating privileges, it will consider again the fundamental question of whether the public convenience, interest or necessity is served by the continuance of the service.

Some of the significant provisions of the amended rules are:

1. The primary purpose of the Class D citizens authorization as a means of communication between units of a single licensee is emphasized.
2. Communication between units of different Class D stations (interstation) is permitted only under certain stated conditions and is restricted to seven designated frequencies (Citizens channels 9, 10, 11, 12, 13, 14 and 23).
3. All interstation communications are limited to no more than 5 consecutive minutes with a silent period of at least 5 minutes before another transmission is permitted.
4. The rules are modified to make it clear that call sign identification shall be made on each frequency used and identification shall include the station being called. Licensees commencing a communication on one frequency and then switching to another channel must give the proper identification of its station on each channel.
5. In general, all users of citizens radio equipment are required to obtain their own licenses and operate under their own call signs. Thus, except in the case of a station used solely for the control of certain remote objects or devices by radio, a citizens radio station may be operated only by the licensee, by members of his immediate family living in the same household, or by employees of the licensee acting within the scope of their employment.
6. The former provision of the rules which prohibited the operation of a citizens radio transmitter under more than one station license has been deleted. Accordingly, radiocommunication for such organizations as civil defense agencies, volunteer fire departments and auxiliary police should, in the future, be conducted under a single station license issued to the organization rather than under licenses issued to individual members of such organizations.
7. The practice of licensees "loaning" their call signs to other persons in order that the latter may operate radio apparatus pending the filing of and action on an application is specifically prohibited by Section 301 of the Communications Act and Sections 95.83(c) and 95.87 of the Commission's rules.

8. A new section has been adopted in the rules which spells out various prohibited uses. Some of them are:
   (a) Activities in violation of law.
   (b) Carrying communications for hire.
   (c) Communications containing obscene, indecent or profane words, language or meaning.
   (d) Communications in the nature of a broadcast or those not directed to specific persons.
   (e) Malicious interference.
   (f) Transmissions of music, whistling, sound effects, etc.
   (g) Communications to stations of other licensees relating to technical performance, capabilities, testing of any transmitter, including transmissions concerning signal strength of frequency stability of transmitters.
   (h) Communications advertising or soliciting the sale of goods or services.
   (i) Communications to another station over a distance of more than 150 miles. (This new limit is far beyond the groundwave communications range under normal conditions. Normally the groundwave range would not exceed 25 miles.)
   (j) Person engaged in selling citizens radio apparatus shall not allow customers to operate under the seller's station license.
9. An individual whose own radio station license has been revoked or cancelled is prohibited from operating another licensee's station of the same class until he is again issued a license of that class by the Commission.

Because there are now some 700,000 citizens radio stations, the Commission is unable to furnish copies of the revised rules to meet requests of individual licensees. However, all citizens licensees are now being required to maintain a current copy of Part 95 of the rules covering this service, hence the subscription method afforded by the Government Printing Office entitles subscribers to receive a copy of these and subsequent citizens rule changes. Meanwhile, the text of the new rules will be published in an early issue of the Federal Register, which may be purchased from the Government Printing Office, Washington, D. C. 20402.

Low Cost Power for Surplus DC Motors

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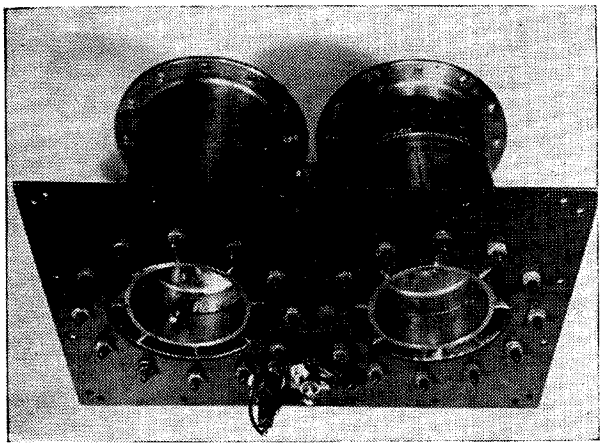


This view of the blower panel using surplus dc blowers shows mounting details of the 20 ampere silicon diode mica insulators insulate the diode from the aluminum mounting plate which serves as a heat sink.

Direct current motors designed for 24 volt aircraft use are a drug on the military surplus equipment market. Not only are the basic motors available in a wide range of types and sizes, but many types of complete motor-driven assemblies are also available. Although prices are extremely low, only those units which meet a "hot" requirement have proven popular. Examples are the prop pitch motor for beam rotator use and surplus motor driven switches such as those featured in a recent 73 Magazine article.[1]

Other amateur motor requirements include fans, blowers, remote tuning drives and motor driven band-switching systems. Many available dc motors are ideal for these applications. In addition, the surplus market is loaded with low cost, dc motor driven assemblies which were custom designed to meet these precise requirements. The problem is to adapt these motors for operation from the ac line.

The ideal source of operating power for all of these motors is a rock-solid, well regulated dc supply. Such an ac operated supply would consist of a substantial power transformer feeding a full-wave bridge rectifier with a modicum of filter. However, provision of such a supply for amateur applications would probably wipe out any cost advantage in the use of the surplus motors.

Most of the available 28 volt dc motors are of two general types: permanent magnet field motors and series wound units in which the field and the commutated armature windings are connected in series. For the permanent

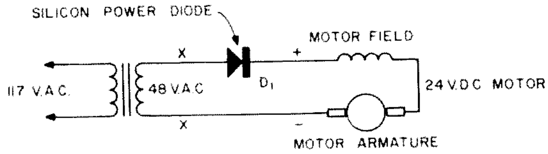


FIGURE 1A

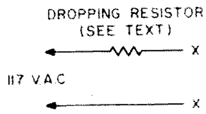


FIGURE 1B

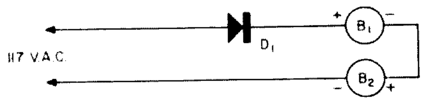


FIGURE 1C

1a Basic circuit for operating 24 volt dc motors from an unfiltered half wave rectifier.
1b Alternate voltage dropping circuit for use in Fig. 1A. Delete the power transformer and connect at points X.
1c Schematic diagram of the blower panel shown in the photographs. D1 is a 20 ampere, 400 PIV silicon diode, Lafayette Radio type SP-269. B1 and B2 are identical, 24 volt dc aircraft blowers.

1 "A Surplus Motor Driven Coaxial Switch," W4WKM, August, 1962.

magnet field motors, dc operating power is an absolute requirement. Operating power requirements for series wound motors are dependent on motor design and conditions of use.

As a general class, series wound motors may be operated from either ac or dc power sources. Special design characteristics are required for use on ac power. These features include use of laminated magnetic materials to reduce hysteresis losses, special winding design and selection of proper brush material. For any particular motor, the speed and torque developed will be greater on dc than on ac. Voltage requirements for ac-dc motors can vary considerably. As an example, I have in front of me a surplus band switching motor which carries a name plate rating of 50 volts dc or 110 volts ac, 25 to 60 cycles. So-called universal motors are specifically designed to operate from either ac or dc power of approximately the same voltage to produce approximately the same output speed and torque.

Now back to the surplus 28 volt dc motors. First of all, almost all of these motors are specifically designed for dc use and as a result have unlaminated magnetic poles and frames and the brushes and windings are designed for dc use. This does not rule out the use of ac power for such motors if they are to be operated intermittently and/or at reduced voltage and output load. The continued successful use of prop pitch motors in beam rotator applications proves this point. If you have such an intermittent or light duty application, then use ac to power your surplus motor. Operating voltage and maximum load must be determined experimentally. Start with reduced voltage and load and gradually increase the voltage until excessive motor heating is observed. Hopefully, the desired speed and torque will be obtained before excessive heating is observed. Good luck!

If ac operation results in excessive heating and a well regulated dc supply is prohibitive, there is still another way around the problem.

This compact transmitter blower panel uses a single silicon diode to power two series connected, 24 volt dc axial-vane aircraft blowers from the 117 volt ac line.

As was pointed out in the referenced article,[1] a single, low cost silicon diode may be used as a half wave rectifier to supply operating power to dc motors. Fig. 1 shows how this is accomplished. Since no filter capacitor is used, the silicon diode, D1, provides the dual function of supplying the required dc operating power and also gives an effective 50% voltage reduction. Thus, for 24 volt dc motors, a 48 volt transformer is required. However, for many applications a dropping resistor may be used to supply power directly from the ac line. The effective 50% voltage drop across the silicon diode will, for many light duty applications, allow the use of a reasonably low wattage resistor. The value of such a resistor must be determined experimentally since it will be dependent on the motor load and the characteristics of the motor. For short duty cycle operation the resistor may be substantially overloaded without damage. For continuous duty applications, the usual power dissipation requirements apply. The silicon diode should have a minimum peak inverse rating of 400 volts. With the low cost of power diodes today, a substantial maximum current safety factor to accomodate the motor starting surge current can be economically provided.

Fig. 1C and the photographs show a rather unusual application of the techniques described above. The blowers shown are axial vane aircraft blowers designed to operate from 24 volts dc. These units operate at 14,200 RPM and use 1/12 HP motors designed for continuous duty use. Operating current is 4.7 amperes and each blower is rated at 60 CFM. As shown in Fig. 1C, the motors are wired in series with the silicon diode and connected directly to the ac line. The silicon diode is a

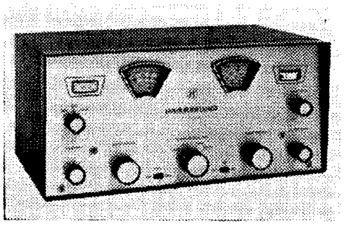
low cost Lafayette Radio unit rated at 20 amperes and 400 PIV. This stud-mounted diode carries the part number of SP-269 and sells for $2.98. Lower current units are available at correspondingly lower prices. This particular blower panel was assembled on a 7′ × 11″ aluminum plate to fit the bottom of a transmitter amplifier chassis. This little unit moves a fantastic volume of air. Vibration is negligible although the acoustical noise level is quite high. As a point of interest, all the neighborhood kids have been in the house at least once to see the "wind tunnel" in action. The blast of air, dimming of the lights (measured 5.5 amperes with 25 volts impressed across each motor) and the sound effects combine for a rather awe inspiring demonstration.

There are a few precautions to be observed in the use of dc motors on ac power, particularly if they are operated directly from the ac line. *WARNING: Many surplus dc motors have one terminal of the power input connected to the frame of the motor. Before use, check with an ohmmeter. If such a ground exists, disassemble the motor and suitably insulate the circuit before operating from the transformer-less supplies shown in Figs. 1b and 1C.* In some instances this ground will be obtained with a strap connection and in others it will be caused by the use of an uninsulated brush-holder. Remove the strap and/or suitably insulate the brush-holder to isolate the wiring from the frame of the motor. Electrical noise from the brushes is quite severe with such motors. While very difficult to completely eliminate, this noise can generally be reduced to tolerable levels by connecting .01 mmfd disc ceramic capacitors directly from the brush holders to the frame of the motor. Room can usually be found to install them inside the motor housing.

If your previous interests have been light construction with drive fabrication limited to fastening the knobs to the control shafts, get with the gears and motor drives. The low cost of drive components and motors on the surplus market makes possible amateur equipment automation limited only by your imagination.

. . . W4WKM

New Products, Etc.



HQ-66

Hammarlund has announced a new general coverage receiver which tunes from 540 kc to 30 mc with calibrated electrical bandspread for the ham bands. The high frequency oscillator is temperature compensated for excellent stability; there is a built in automatic noise limiter; the selectivity varies to produce hi-fi on the broadcast band and a sharp response on the short waves. The front panel is conservatively styled. Price is $159.95. For further info write to Hammarlund, 53 West 23rd Street, New York 10, N. Y.

50th Anniversary

Truthfully, these 50th anniversaries have left me a little cool. It isn't my fault I'm a youngster, is it? National is celebrating its golden anniversary this year, though I guess they have been somewhat eclipsed by ARRL's ditto. This is unfortunate, for National has been an important part of ham radio and they deserve some lauding.

National had been around for 23 years when I first got started in ham radio in 1937. At that time their SW-3 was very popular and many of the shacks that I visited sported this excellent regenerative receiver. The NC-100's and NC-101's were in all the ads, but I knew few hams that had *that* kind of money. I remember that the deep voices on those exclusive 75 meter nets were using HRO's, but we peons didn't see much of them except in photographs.

So now here we are in 1964 and National is announcing a new HRO, the "500." Gone are the plug in coils . . . gone are the tubes . . . gone is the old PW dial. The HRO-500 is a solid state frequency synthesized phase lock receiver. I suspect, when we see it, that it will

be as far ahead of its day as the HRO was when it came out in 1933.

One product of this magnitude is usually all a company can get ready for production at any one time . . . but National has also announced their NCX-5, a new five band sideband transceiver!

The way they're going, if ham radio continues for another 50 years, National will be right there on top of the heap. Watch for the NCP-KW, the self-powered automatic calling self band selecting satellite communicator.

Mobile Gallon Coils

The Webster company has been making their compact Band Spanner for over 14 years. It helped make mobile operation respectable eliminating the monstrous whip and loading coil that used to give the XYL apollexy. A few years ago they brought out the Top Sider with easily replaceable coils for quick band changes. Now the transceivers are in a power race, so Webster has a new line of inductors for the Top Sider, the Gallon series. Now you can run power and not have your car look like a WW2 jeep. The coils are rated at 1000 watts PEP and are about twice the size of the standard (300 watt) size. For more information, write Webster Manufacturing, 317 Roebling Road, South San Franscisco, California.

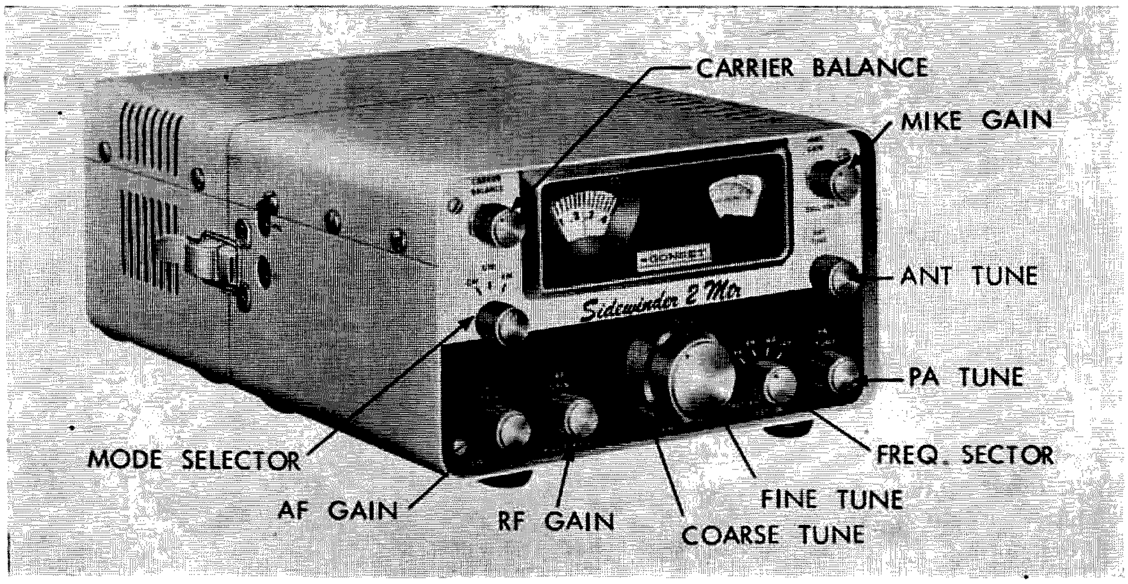
Clean Contacts

George P. Oberto K4GRY

To keep that bug or straight key in good working shape its keying contacts should be kept clean. Relay cleaning tape, ,type K. S. 6528 is available from Hope Webbing Co., Inc. or can be gotten from electrical and electronics places that deal with relays and Teletype.

Every so often a clean tape is run between the keying contcats with the keying contacts closed once the tape is put between the contacts. Pulling on the tape will really clean those dirty contacts. Pull again with another clean tape if the first one gets dirty to make sure he contacts are good and clean. This takes about half a minute. A package of relay cleaning tape will last for years and of course the tape comes in handy for cleaning contacts on RTTY keyboards, TD's relays and so on.

. . . K4GRY



The Gonset Sidewinder

Wayne Green W2NSD/1

Since sideband is still in the early stages of use up on two meters I was quite surprised to see the ads for the Gonset two meter Sidewinder a few months back. I didn't expect to see anything like that for a couple more years. I think that all of the regular two meter denizens will join me in stating that we are all happy to see this piece of equipment available.

Sideband is just as advantageous on two meters as it is down on 20. Back in the days when it was possible to have a clear channel on 20 (I'm *old*, eh?), the early users of sideband were able to appreciate the unbelievable way we could get out, even with low power. If you've done any listening to the sidebanders on two meters you know that they are able to work over extraordinary distances.

Which brings us to the Gonset Sidewinder. This is a far cry from the old Gonset Communicator I. With this package you not only have an AM transmitter (6 watts input and receiver, but also a sideband transceiver (20 watts PEP) and everything except the higher power transmitter stages is transistorized. The power supply unit snaps right on the back of the transceiver. They have both twelve volt dc and 115 vac supplies, but I think I would go for the 12 volt job and then make a small power pack to deliver the 12 vdc at 8 amps required for shack use rather than buy both supplies. Then you could whip it into the car whenever you wanted.

The Sidewinder is small enough to fit in even a sports car. Bless transistors. And the power it requires shouldn't hurt your car. I counted 21 transistors and three tubes, ending up with a 6360 in the output. I.F.'s are on 15 mc and 9 mc.

That's all fine and good, but how does it work? Shortly after the Sidewinder was delivered up here in the wilds of New Hampshire I was heading for 73 Mountain to see what would happen. I hooked it up to a spare two meter antenna and listened around. I am not sorry to report that my 417A converter had a slight edge over it in sensitivity. Transistors may be pushing Nuvistors at two meters these days, but the 417A still can do a little better. No matter, there were darned few stations that I couldn't hear quite well on the Sidewinder. The stability of the receiver isn't important on AM, but it is greatly appreciated on SSB.

I tuned to 144.1, where the SSB gang hangs out, and called a quick "break" at the first opportunity. W2LVQ was on the channel having a round table with a station in Plaistow, New Hampshire and Boston. He came right back when I spoke up . . . not bad for 20 watts PEP at 200 miles, eh? All three critically listened to the signal and gave it a clean bill of health. Since then many SSB stations have been worked down into Southern New Jersey, over 300 miles from here. I don't do an awful lot better than that with my kilowatt on AM.

Gonset has worked out the tuning system well. There is a switch for selecting the megacycle and both fast and slow tuning of the main dial for plain tuning and zeroing in on SSB.

The Sidewinder sells for $399.50. The dc power supply is $79.50 and the ac supply is $67.75. This is pretty remarkable when you consider that the Communicator IV was up over $400! For not much more you have everything you had in the IV plus stability, SSB and CW! I suspect that the Sidewinder will put a lot more fellows on two meter sideband.

Letter

Dear Wayne:

Your competition sure has put much needed life and renewed vigor into previously decaying ARRL. Keep up your good work. Heretofore ARRL has had a monopoly in the amateur radio business and therefore had a tendency to go dead at the top. In any field of endeavor competition is usually the best productive process upon final anlaysis. ARRL should not be allowed to have a monopoly in the field of ham radio. Don't let the ARRL hounds get too close to your tail. Good luck.

African Hams

Name of Country and Prefix	Permanent licences.	National society	Licences granted to Visitors
BURUNDI (9U5)	Less than 10	No	Yes
CAMEROUN (TJ8)	None	No	Yes
CENTRAL AFRICAN REPUBLIC (TL8)	Less than 10	No	Yes
CONGO REPUBLIC (9Q5)	Over 120	U.C.R.A. Leopoldville	Yes
DAHOMEY (TY2)	Less than 5	No	Yes
GABON (TR8)	Less than 10	No	Yes
GHANA (9G1)	About 50	G.A.R.S. Accra	Yes
GUINEA (7G1)	None	No	Occasionally
IVORY COAST REPUBLIC (TU2)	Less than 20	No	Yes
MALI (TZ)	None	No	Occasionally
MAURETANIA(5T5)	Less than 10	No	-
NIGERIA (5N2)	About 40	N.A.R.S. Lagos	-
NIGER REPUBLIC (5U7)	Less than 10	No	'Dxpedition' operation discouraged
REPUBLIC of the CONGO (TN8)	About 25	Closely linked with R.E.F.	Yes
RWANDA (9X5)	Less than 20	No	Occasionally
SENEGAL (6W8)	Less than 25	Closely linked with R.E.F.	'Dxpedition' operation discouraged
SIERRA LEONE (9L1)	Less than 10	No	Administration favourable to Amateur Radio
SOMALI REPUBLIC (6O)	Less than 20	No	Yes
SUDAN (ST)	None	No	-
TCHAD (TT8)	Less than 10	Closely linked with R.E.F.	No knowledge of visitors obtaining licences.
TOGO (5V)	None	No	Visitors have obtained licences in the past.
UPPER VOLTAIC REPUBLIC (XT2)	Less than 5	No	" "

(credit to I.A.R.U. Region 1 Bulletin)

Letter

Dear Wayne:

Congratulations on the July issue. It came just at the right time here as interest in the vhf bands is starting to put a hammer-lock on me. The VHF Buyer's Guide added the finishing touch. I very much like the idea of running special issues with numerous articles pertaining to one phase of amateur radio, such as these last two issues have been.

CQ is setting a record I bet you will never beat, Wayne. They are sending my copy later each month, this time 9 days behind QST and 14 days behind 73. I simply had to wait until I had laughed my way through their editorial before writing this letter. It turned out rather wishy-washy, but this was probably due to the fact that a new editor is at hand for CQ. Its misrepresentations, twisted facts and just plain lies smell of Arne Trossman, but the whole tone and style of the work is foreign to other ZB columns, such as the May masterpiece. When you get right down to it, the author seems to be spoon feeding his message to the readers with the too frequent use of the word—they—instead of who we know the editor meant. Is this a preview of K2MGA?

But the grabber of the issue was the letter box! . . . Congratulations on making CQ once again a responsible voice in ham radio. . . . Factual, to-the-point, hard hitting . . . you speak purely for the cause of TRUTH . . . tests of NC-300 with a SteamRoller . . . (it was actually an NC-109; Mr. Oliver seems to have lost his memory along with his sense of humor) . . . echhh to all of the above comments. I must also thank WA2TGC for his expose of Goat Boy's identity, previously unknown to the amateur public; I feel sorry for you Ted, with friends like WA2TGC, enemies must be a luxury.

Although CQ did print one letter against the May editorial, I really wish it had been one of the ones they received that tore into the deceptions of the article, piece by piece. I also noticed that one reader plans on blaming you for any frequencies lost at the next ITU Conference. Hmmm, I suspect that you are the direct cause of my brother getting grey hair at the age of 13, too.

Bill Orr misnamed his article; it skimped on predictions of Amateur Radio Tomorrow and gave us a history of the ITU and past Conventions, something we could have gotten from past issues of QST.

Back to the editorial of CQ for July, in the middle of the fifth paragraph, the sentence starting—They will accuse ARRL officials of being corrupt . . .—one of the most exposing essays on the corruptness of the League was writen by one of CQ's own column authors, K6BX, in his "Doyle Dairy" letter. QST said nothing at all on this paper, and it must be assumed that the ARRL could not deny the accusations of Clif's.

Before ending, one question Wayne, what was the outcome of your poll on RM-499? And(ha), did any ARRL officials show up to count the ballots?

Bob Sverstedt, WA6VAT

No, Bob, no one has hown up yet. The ARRL HQ gang knows that the 73 poll was accurate, so why on earth would they waste time coming up here to be embarrassed? Re CQ, I was under the impression that Cowan was writing the editorials. Re WA2TGC, since "Cuke" never has been a 73 reader he didn't know that I had not ever identified Goat Boy.

Long Sky Rubbish Wire

Mrs. Harry Pennington, Jr. K5HVZ
134 E. Agarita
San Antonio, Texas

When a rare DX YL turns out to be your own daughter, it is indeed rare DX. VR4CM, Mary Pennington Cowmeadow, formerly K5HVX, is now living in the Solomon Islands. Her first radio contact was with, of all people, her parents, this week. Naturally, her delirious parents had planned it that way, but who could tell how long it would take to erect

an antenna on the top of a 35 foot bamboo pole, over an exotic red blooming Royal Poinciana tree to the back landing of their transient quarters in Honiara, Guadalcanal.

Mary and her husband, Arnold Cowmeadow, a Crown officer in the Forestry Service of Great Britain, will be stationed in the Solomon Islands for the next two years. They met last year while they were both students at the University of Edinburgh in Scotland. Mary came back to the University of Texas last fall to finish her senior year. Arnold arrived here around Thanksgiving. They were married in December. Arnold then went on to the Solomon Islands and Mary stayed to finish the semester and followed him to the Islands in February. Since then they have been in the jungle most of the time. His work is to enumerate and survey the forests. They have recently been assigned a new houseboat and launch, which will soon sprout a Zed L Special beam to her transceiver.

Mary's ham adventures in the South Pacific began before she got out of Texas when her plane taking off from Dallas had to dump 3000 gallons of gasoline from the air. The retractable landing gear had refused to retract, forcing an emergency landing on a foamed runway. Her fear was not in whether or not they would get the plane down safely but would she now be able to make her connections on New Guinea's weekly plane to Guadalcanal. Another plane was brought into Dallas and they flew out to San Francisco making up more than thirty minutes. She had a breathless connection with the QANTAS flight to Hawaii, Fiji and Sydney. Meanwhile back to the home ham shack, we K5HVW and K5HVZ were frantically calling for Vince, VK2VC and Ed, VK2EN in Sydney, Australia. Vince and Ed, several years ago, made a trip around the world and stayed with us for three days while in the United States. They met Mary at the Sydney Airport at the unearthly hour (for hams especially) of 7 AM. For the next thirteen hours of her layover, they were marvelous hosts, showing her all of the sights of beautiful Sydney. At nine o'clock that evening they took her back to the airport. As the officials were checking her passport, it was noticed that she did not have a visa to land in Guadalcanal. No amount of persuasion from Vince and Ed could get her on the only flight that would connect with the weekly plane out of New Guinea. Here indeed, are ham friends at their best. Ed's wife, Mary Hulme graciously invited Mary to stay with them in their lovely Pacific beach home. For the rest of the week they drove her around Southern Australia. They helped her straighten out her visa problem. Ed took her to his electronics plant in Sydney and they inspected his brick kiln. She went bowling with Ed's family and swam in the Pacific (in February-summer?). She was able to make contact with Arnold in Guadalcanal who arranged to meet her in Munda, New Georgia, where the surveying party would begin their jungle trek.

Some years ago when the girls were teenagers, we had almost consecutive calls: K5HVV, K5HVW, K5HVX and K5HVZ. As the girls went off to college in Virginia, Randolph Macon Woman's College, we were able to maintain regular schedules. Barbara, our older daughter, now Mrs. Ben G. Bailey, lives in Atlanta, Georgia. We have twice weekly schedules with her and her new call WA4KFC and the two year old granddaughter. Granddaddy already has that look in his eye: "I wonder if she is too young to learn code?"

Mary has now been in the jungle with Arnold on four different trips lasting from three weeks to a month each time. Once she was quite alone in her tent when she realized that her solitude has been interrupted by a four foot long iguana. Several days ago she reported that even the native boys were panicked when they

killed a three foot poisonous sea snake on the deck of their houseboat. She said as they docked in a village port, she was bewildered to find that the sick villagers lined up in front of their boat expecting medical care. Since she has been back in Honiara (home of the winds) she has been studying daily at the hospital under a doctor and Fijian nurse for a course in first aid and out-patient care. She reported last night that she had given her first penicillin shot and observed (without fainting) the sewing up of a woman's foot that had been chopped with an ax.

Mary is fast becoming fluent in Pidgin English. A car is called a "schooner belong bush". A headache is "sore leg belong head." Even the newscasts are given in pidgin; as well as a daily medical care program that is broadcast through out the Islands in pidgin.

The day her ham gear arrived, she rounded up a collection of houseboys (calico lap laps) to help with her antenna erection. She had the guy wires attached to a 35 foot bamboo pole, then she signaled for everybody to lift. It became increasingly obvious as the pole stalled that the guy wires were too short, so down it went for modifications. With the new longer guys spliced in and a second erection about to begin, a car rounds the corner and unseeingly becomes impaled in her wires. This time it was really (bugger up finish) and less than an hour before her schedule with her parents. Extracting what was left of the guys and antenna, she again started over; obviously the long awaited first schedule would again be delayed. This time a land rover arrived filled with forestry department personnel. They fell on the project with efficiency and speed and had her (rubbish wire long sky) in place five minutes before schedule time. (Rubbish is the opposite of number one.)

Mary signed out last night with "I love getting DX, but *being* DX is the greatest!"

Bagpipes and the Phone Men

Hector French W1JKZ
9 Davidson Road
Wakefield, Mass.

A lot of phone men are proud of their crisp, clean audio, even when it isn't. The circuit fanatics will even give you a blow-by-blow account of what's going on in their speech department, all the way from the mike to the antenna. That's fine—but does anyone know where this speech energy comes from in the first place?

If you ask a medical-style Doctor, he'll reply that speech comes from the interaction of complex groupings of neuro-muscular systems, under the control of the bain. Then he'll charge you nine dollars.

Well . . . I'm not sure that this reply does much good, and in the second place I didn't understand it, and in the third place it wasn't worth nine dollars in the first place.

"73" readers will therefore be happy to learn that they can save those nine dollars, and buy a three year subscription instead, because this issue of "73" is about to answer that old, old question: "Why is the phone man?"

The answer is clear. Here it is: The great American phone man is built like a bagpipe, and works the same way.

Does he sound like one? Read on.

The leather wind-bag under the piper's arm, for instance. This furnishes the air for the pipes. The piper keeps the bag full of air, through a blow-pipe he holds in his mouth.

The phone man works in just the same way. His lungs are like the bag of wind, and he forces out the air with his respiratory muscles. You're probably not conscious of these muscles if you've been breathing regularly lately, but you can feel them working by imitating the ho-ho-ho of Santa Claus.

When you try out this ho-ho-ho (without the wife and kids around; they'd think you'd just blown your cork), stand up to do it—don't sit down. And be sure to make it a vigorous one. When you do this, you may find—and you will find, if you've done it with plenty of that old enthusiasm—that you're forcing out the air by using all of the muscles from your chest down to your abdomen.

Now try it again—but this time sitting in your chair, with your feet up on the table. See the difference? Standing, your voice can sound like the pipes calling the clans. Seated, all scrunched up, your voice is more apt to sound like a two-bit harmonica, under a blanket, in the rain.

So who wants his QSOs standing up? Not many; I know I don't. But at the very least, keeping to a good seated posture is guaranteed to improve the clarity of your voice, to help you get through the QRM, and to project a better image of the person behind the mike.

So let's go back to the bagpipes again. I've spoken of the wind in the leather bag. This wind is forced out through a double-reed sort of affair at the wind-bag end of the chaunter, or chanter. These double-reeds have just enough room between them for the air to pass through. As it does, this air sets the reeds into vibration, to modulate the air stream and form some of the sounds which eventually come out as music. (My neighbor says that the wind from a bagpipe will never be music, but that's his opinion.)

The phone man works in just the same way. His larynx (Adam's apple; voice box) contains a pair of muscles which have just enough room between them for the air to pass through, just like the double-reed in the bag-pipe. When the air passes through, it sets these muscles into vibration, to modulate the air stream and form some of the sounds which will eventually be shaped into speech.

There's one important difference, though, between the reeds in the pipes and the muscles in the larynx. The bagpipe reeds are merely a pair of reeds, and that's all. The muscles in the larynx are under the control of the speaker. He can change their tension and spacing, to help determine the frequency and waveform of his vocal noises.

This difference makes for a lot of trouble, as far as a 100% QSO is concerned. Here's why: these two muscles aren't the only ones in this part of the throat and neck. All it takes is a little tension, or fatigue, or bad speech habits, and these other muscles will tighten up to give a tensed, pinched, flat, unpleasant tone of voice. Singers and wind instrument musicians have to learn how to keep these other muscles relaxed, so they won't interfere with their tone production. If I tighten up these other muscles, my clarinet tone and intonation go all to pot. Wouldn't it be logical to assume that something similar applies to a radiophone conversation, so that a more efficient formation of the speech sounds would result in a more efficient use of the modulation capabilities of the rig?

Here's a little experiment you might want to try. It not only demonstrates what happens when you relax these other muscles, but it will help you learn where they are, what they feel like, and how to relax them. This time, have the XYL on hand to listen; she probably heard you going through that ho-ho-ho routine, anyhow.

Here's what you do: sit in a comfortable chair, one that lets you relax, but still gives you a firm support, for a good seated posture. It should support you to your shoulders; there should not be a head rest.

Now speak a few sentences to the XYL as a standard of comparison. Recite "Mary Had a Little Lamb," or read off the index to this issue of "73," or recite any familiar sentence or verse.

Are you relaxed? Fine. This experiment is

actually an exercise; take about ten seconds to go around the circle once.

First, you let your head roll forward by its own weight, until your chin is just about touching your chest. Don't force it; let it go of its own accord. Then roll your head slo-o-owly over to the right, until it is resting on your right shoulder. Don't stop; roll your head along smoothly towards the back, until you're looking up toward the ceiling. (Don't force; let it go by itself). Keep going . . . over on your left shoulder . . . forward to your chest . . . relax a moment, then raise your head.

Now repeat the same sentence or verse you gave before. Surprised?

I had a friend try this whose voice usually sounds like a nervous breakdown looking for someone to happen to. After going around this circle exercise just once, his voice changed completely—for a couple of minutes, anyhow, until his regular speech habits took over again. His voice had turned big and deep, and as relaxed as a wet noodle. The kind of voice that commands respect on the air, and anywhere else, for that matter.

But I'm getting away from the bagpipes. When I left off, the air was going through the double-reeds, which were vibrating to modulate the air stream, and make a noise which the piper will control to make his music. To do this, the chaunter through which this modulated air stream passes has a series of holes along its length. The piper places his fingers on these holes and plays the chaunter like an oboe, to form the series of notes, trills, shakes, cuts, and warblers known as bagpipe music.

The phone man, now . . . the noises from his larynx are just that: noises. Just as with the piper, the phone man must control these noises, to form the sounds of speech. He does this by the tension and spacing of the muscles in his larynx (just described), and by the positions of his tongue, jaw, and lips.

Here's where the phone man runs into his most common fault: lazy pronounciation. He's apt to share the great American speech malady of "the mumbles." He doesn't open his mouth wide enough, for the sound to get out; he doesn't waggle his jaws as much as the syllables require; he doesn't bother making his tongue nimble enough to form his vowels and consonants so they don't all sound alike.

Here's where the XYL can help in some more experiments, this time in trying to improve your percent intelligibility by a more careful formation of words. What you'll do is this: leave on a couple of radios and the TV, to give some QRM. Find a pair of locations where the XYL can hear only about 80% of what you're saying, when you read to her from the paper, for example. Then when you've a good idea of how much she misses when you're speaking normally, try using this more vigorous word formation, and see if it helps. Look for more motion of lips, jaw, and tongue, not for more volume.

You might run into a little trouble here if you concentrate on your mouth motions too much—you'll end up like the caterpillar that starved to death because he couldn't figure out which foot to move next. What may happen to you is that all this concentration starts to interfere with a procedure which should be automatic, to the point where your voice starts to sound artificial, and not like yourself at all.

There's a simple cure for this tendency: whisper the words first. When you're whispering, you use a much more complete word

73 Products and Publications

6UP Magazine. The only fullfledged monthly devoted to VHF. Invaluable to the Technician and the VHF/UHF DX'er and experimenter. Activity reports on all band openings. Wide band FM news. Six meter news. Two meter news . . . 220, 432, 1296 . . . etc. Construction articles, antennas, etc. K5JKX editor. **$2 per year.** Don't miss a single copy of this interesting magazine.

ATV Bulletin. The Amateur Television Experimenter is the only publication devoted to ham-TV. Circuits, operating news, conversions of surplus gear, ads for TV gear, discussions. WØKYQ editor. $2 per year, published bimonthly.

Binders. Bright red leather gold stamped with 73 and year. Specify 1960-1, 1962, 1963, 1964. **$3.00** each.

Bound Volumes. Only a few left. 1960-1, 1962, 1963. A very few. Beautiful red leather. **$15 each.**

WØKYQ editor. **$2 per year,** published bi-
Impedance Bridge. Full scale construction prints for the bridge described in the August 1961 issue of 73. Comes complete with a reprint of the article. Watch out General Radio! $1.00

SSB Transceiver Schematic—W6BUV. Giant size schematic of the transceiver that appeared in the November 1961 issue of 73. Complete with extra November issue. $1.00

73 Inc

Peterborough, N. H.

formation with your mouth, since you don't have any sound from your larynx to work with. Then, when you've found out by whispering how you should have been forming these words all along, speak it out loud the same way and see if the XYL notices an improvement in intelligibility.

There's another trick to improving your intelligibility that vocalists and orators use all the time. Bagpipes don't need it, because when you hear a bagpipe, you know what it is—but a vocalist has to be able to cut through the QRM of a whole team of musicians competing with her at something like 30 db over S9, and make sure you get every word. Seems just the thing for phone, doesn't it?

Here's the trick: just form the words as far forward in your mouth as you can. I can't tell you how to do it by analyzing what goes on inside your mouth; you'll just have to try it yourself until you get it. Your voice will have a new ring and clarity, with a slight flavor of coming down with a cold, since you're now including the very-important resonant chambers of head and noise in your speech production. This front-of-mouth word formation has a lot to do with the ability of some amateurs to be heard and understood at a signal-to-noise ratio that leaves everyone else down in the mud.

Then, if the XYL is still listening, try them all out on her: body relaxation, for a freer use of the breathing apparatus; throat relaxation for a relaxed, bigger tone; more vigorous use of mouth, jaw and lips, together with word formation toward the front of the mouth, for improved clarity. Try it out on yourself with a tape recorder, feeding in known amounts of QRM. Try it out on the air to see if you get reports of improved audio, or of cutting through the QRM any better.

One last item; very important. It's this: there's a lot more to it than just cutting through the QRM and making contact. There's also the matter of courtesy, of making the other fellow sound as though you're interested in the QSO. Why should be bother listening if your voice doesn't sound interested, either? A firm, clear voice commands respect, on the air as well as anywhere else; tune over the band some night and see if this isn't so. Remember, when you're on the air, your voice isn't just a medium of communication: your voice is you.

So have fun. Here's to good rag-chewing, and lots of DX.

And if you know where I can get a good bagpipe, let me know.

. . . W1JKZ

(W2NSD from page 4)

mitter to operate K2US. Letters from several other visiting hams, some permitted to operate, some not.

There seems no question now that the Washington Amateur Radio News, ARRL's unofficial hate sheet dedicated to the downfall of the Institute of Amateur Radio, is being sent to all IoAR members listed in the July issue of 73.

Here At 73

With the closing down of the Parts Kits program and the Radio Bookshop, we've been able to get to work on other projects. One of the first was the printing of the amateur regs for the Institute. Next we printed a good sized book of articles that have appeared in the past issues of the ATV Bulletin, most of which are long out of print. This book is a must for all of you interested in ham TV . . . $3. Next our little press swung into action and turned out a book on test equipment and how to use it. You can do a lot of things with your test gear you never thought of. Then we printed a book on Parametric Amplifiers which VHF men should find invaluable. Paramps are getting down to where you can build them yourself and get them working. This book shows you just how to do it.

The press hasn't had a chance to cool for quite a while. As soon as the Paramp book was done we put out 6-UP and started printing our VHF/UHF Antenna Handbook. Our Receiver Handbook is on the way and should be done before the end of August. All this printing has been made possible by our acquisition last spring of a 3000 pound paper cutter and a huge paper folder.

Though I really haven't had the time, I've been going up to 73 Mountain two or three nights a week and operating on six and two. Six was opening up frequently during early July and late June and I worked about 600 different stations in some 40 states. The best DX was California. The 500 watts and 16 element Cushcraft Colinear made DXing a snap.

The real thrill was down on two meters. Here I had a 336 element Cushcraft Colinear-Yagi antenna and 500 watts. The results are almost beyond belief. On a normal evening of operation I contact between 80 and 100 different stations during a four hour stint. Most contacts are hello-goodbye, but sometimes I get wound up answering questions and talk for a half hour or more. It takes me from two to three hours to tune from one end of the band

to the other, working stations as I tune up the band. The bulk of the contacts are down in the New York City-New Jersey area, but they go right on down to Hampton, Virginia. K1IED/4 in Hampton calls me almost every night that I operate and lets me know how my signal is doing down there. Normally it runs around S-6, but he has heard it 25 db over 9!

Under normal conditions I have no great problem in working fellows in New York City with Twoers and a five element beam. I've worked Twoers all the way down to Baltimore.

When I first got on with the Big Signal I figured that I would work fellows as fast as I could and that eventually I would have given everyone a contact with New Hampshire that wanted it. Then I could settle down and rag chew. Haw! I've contacted over 800 different two meter stations so far in the last six weeks and there is no sign of my running out of new contacts. I may *never* get to rag chew on two. I'm not complaining.

I sure would like to work some fellows down in North and South Carolina. I'll try to be on every Tuesday and Saturday night on about 145.000 mc at 2300 local time on CW and listening for calls around that frequency or between 144.0-144.1. I'll be on as many Fridays and Sundays as I can too.

. . . Wayne

(Sixer Linear from page 15)

Then cut off the rf input drive, apply plate and screen voltage and tune C1 and C2 over their ranges. No self-oscillation should occur. It is assumed that everything is in good working order, that the grid and plate circuits tune well above and well below the 50 mc band. Actually these tests above are *final* ones. The whole process should be repeated several times in order to be sure that everything *is* in good shape.

Linear Tune-up

The rig should work OK if you make it up as shown. However, I advise you to check with a 25 watt bulb as a dummy load first. With between ½ watt and a watt input, you should get 20 to 25 watts output, using 350 to 450 volts and 100 to 150 mils on the plates. Be sure and *overload* the plate coupling! Linears like that! Without load you should get a good 50% plate dip in current, and good fat smoky sparks with a pencil (wood!) on the plates.

Listening with the diode, transistor amplifier, and padded earphones, you *should* hear the kind of modulation you like to hear. Overdrive the grid circuit and see if you can make it distort. It *should* when you go up much over a watt on the driver output. You then reduce

it back to where it sounds good. Your Sixer may not be able to drive it that hard. You will easily find the input level that should not be exceeded. Incidently, though not surprisingly, the drive can be increased if more plate and screen voltages are applied to the linear. You can go up to 500 volts if you really insist. Just watch those plates for color! I could not see any color at 60 watts input. With 25 to 30 watts output without modulation, and more with modulation.

On The Air Tests

I put up a portable four element 6 meter beam about 10 feet over the roof with RG-8/U feed line. Using close coupling between L3 and L4 and *no* plate dip, I listened in with the diode for linear results. Sounded OK, so I stood by on the band. A heavy call came on, "I've been listening to you Bill ever since you put that carrier on. Sounds great." That was encouraging. Worked around ½ dozen stations until a lot of QRM from Florida and Iowa started up. (*Yes*, on 50 megacycles!) Of course, if you've been on 6 working locals and such for weeks on end, DX is alright.

Comparisons between the "bare-foot" driver and the same with the linear added shows quite a difference alright. On distant stations, like Lyndboro, N. H., 47 miles airline, the signal at one watt is near the noise level with a Sixer, but with the linear added reports were "Solid copy, S 9." Well, you know those S-meters!

The whole business of an AM linear boils down to this; you've got a $1.75 tube dissipating some 20 to 25 watts and putting out a fully modulated signal of some 30 watts, with quite a bit more on modulation. This is driven by a less than one watt signal from the Sixer or other little unit.

Just remember, to repeat, as it says on page 19, RCA TT5, "The maximum efficiency of an AM linear varies from approximately 33% for an unmodulated carrier (who needs one) to an approximately 66% for a fully modulated carrier."

What more do you want from a $1.75 tube and a one watt modulator?

. . . K1CLL

Subscriptions

If you like 73 we'd appreciate your help in getting more fellows to subscribe. The big difficulty is to overcome inertia and actually get them to sit down to get it done. We try to make it as simple as possible on our end. The price is a simple (and low) $4. Our address is simple: 73, Peterborough, N. H.

MASTER ORDER BLANK

73 Subscriptions

Name__________ Call______

1 yr $ 4.00______ Address__________

2 yr $ 7.00______ City______ Zone____ State_____ Zip____

3 yr $10.00______

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LIFE $50.00______ 6up $2____ ATV $2____

New sub.______

Renewal sub.______ IoAR Membership 1 yr $10____

Start with______

Back issues (50c each)__________

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7	7*	14	14	14
ARGENTINA	14	7	7	7	7	7	14	14	14*	21	21*	21*
AUSTRALIA	14	14	7	7	7	7	7	7*	7	7	14	14
CANAL ZONE	14	7	7	7	7	7	14	14	14	14*	21	21
ENGLAND	7	7	7	7	7	7*	14	14	14	14	14	7*
HAWAII	14	14	7	7	7	7	7	7	14	14	14	14
INDIA	7	7	7	7	7	7	7	14	14	14	14	7*
JAPAN	14	7*	7	7	7	7	7	7	7	7	14	14
MEXICO	14	7*	7	7	7	7	14	14	14	14	14*	14*
PHILIPPINES	14	7	7	7	7	7	7	7	7*	7*	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14*	14
SOUTH AFRICA	7*	7	7	7	7	14	14	14	14*	14*	14*	14
U. S. S. R.	7	7	7	7	7	7	14	14	14	14	7	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	14	14	14*	21	21*
AUSTRALIA	21	14	7*	7	7	7	7	7*	7	7	14	14
CANAL ZONE	14	7*	7	7	7	7	14	14	14	14*	21	21
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	7
HAWAII	14	14	14	7	7	7	7	7	14	14	14	14
INDIA	7	7	7	7	7	7	7	7*	14	14	7*	7*
JAPAN	14	14	7	7	7	7	7	7	7	7	14	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	7	7	7	7*	7	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14*	21	21
SOUTH AFRICA	7*	7	7	7	7	7	14	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	14	14	7*	7	7

WESTERN UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7*	14	14	14
ARGENTINA	21	14	7	7	7	7	7	14	14	14	21	21*
AUSTRALIA	21	21	14	7*	7	7	7	7	7	7	14	14
CANAL ZONE	14*	14	7	7	7	7	7	14	14	14	14	21
ENGLAND	7	7	7	7	7	7	7	14	14	14	14	7
HAWAII	21	21	14	7	7	7	7	7	14	14	14	14
INDIA	7	14	7	7	7	7	7	7	14	14	14	7
JAPAN	14	14	14	7	7	7	7	7	7	7	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14*
PHILIPPINES	14	14	14	14	7	7	7	7	7*	7	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14*	14
SOUTH AFRICA	7*	7	7	7	7	7	7	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	14	7	7
EAST COAST	14	14	7	7	7	7	7	14	14	14	14	14

* Means next higher frequency may be useful.

September 1964

Good: 6-11, 18-21, 26-28
Fair: 1, 4, 12-14, 17, 23-24, 29
Poor: 2-3, 5, 15-16, 22, 25, 30
(High MUF and/or freak conditions)
Es: 7-12, 19-21

J. H. Nelson

73

October 1964
A Conservative 40c

A HAM IN THE WHITE HOUSE ?

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

October, 1964

Vol. XXIIII, No. 1

Cover:
Wayne Pierce, K3SUK

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de W2NSD

never say die

432

432 is a real comer. I hope you'll note that a good deal of this issue is devoted to trying to arouse your interest in giving 432 a try. Everywhere I go I am finding that fellows are getting on 432. Some are doing it the hard way, with lathes and coaxial tanks, others are snipping circuit-board a-la Hoisington.

Most of us will live to see the day when 432 is our biggest DX band, if we can beat off the commercial interests who realize what this band is worth and are working on getting it away from us. Many of the fellows working on the communications satellites are hams and one of them recently came up with an estimate of what we might have to spend to build a set of three 432 mc repeaters for fixed orbit use, a placement which would permit us to contact any place on earth on this band. While I can't speak for future elected directors of the Institute of Amateur Radio, the present Interim Directors feel that this is an extremely worthwhile project to be underwritten by the Institute. The costs are estimated at about $200,000.

This is a big order, but just contemplate the probable results. Relatively QRM-free contacts will be possible between any two or more amateurs anywhere in the world using fairly inexpensive and simple equipment. Our 30 mc wide band would accomodate 10,000 simultaneous round tables (using SSB). That should hold us for a while.

Self Appointment

The fellows used to laugh at "Richie" because he would come running to the control room every time we dove to make sure that everything was alright. They teased him about "carrying the boat on his shoulders." However there was something very reassuring about having this man always standing there ready for an emergency . . . a man who knew every one of those thundreds of control valves intimately. A submarine is a ticklish proposition at best and we breathed a little easier when Richie went flying past, day or night, on his sixty yard dash from the maneuvering room or after torpedo room up to control.

I guess I'm in about the same position today with respect to amateur radio. I'm trying to carry ham radio on my shoulders. Some of you kid me about it. Some of you hate me for it. Some appreciate it. While the appreciation feels good and the hate hurts, neither change me any more than ridicule or cheers changed Richie. It is a question of accepting responsibility for something.

Sure, I know, nobody asked me to take the responsibility. But isn't responsibility always a purely voluntary thing unless you have a threat to back up irresponsibility?

So, here I am, sitting at a battered old $5 desk up in the mountains of New Hampshire . . . wondering if I should continue on or maybe just throw in the towel.

My mind goes back over the past few years, trying to discover how I got in this situation.

One of the first turning points was back in 1948 when I first heard the "jingle bells" on the high end of two meters and became interested in radioteletype. The second turning point was in 1951 when I got a television directing job out in Cleveland and the station had a mimeograph machine. Thus began my ham writing career as I printed volume one number one of the Amateur Radioteletype Bulletin. In 1952 I began my column on RTTY in CQ. I was in the big time.

Being rather close to CQ, I knew that the editor was having great troubles with Cowan and was anxious to leave. In December 1954 he left to become editor of popular Electronics, leaving CQ editorless. Somehow, in spite of the fact that I was running a successful hi-fi manufacturing business, I let myself be talked into editing CQ on a part time basis. The magazine was, I understood, losing money and was being supported by Cowan's only other publication, Radio Television Service Dealer.

In view of this financial problem I agreed to start in at a low salary as long as I would have a share in any success I might bring to the magazine. I made a great mistake in just

shaking hands on the deal instead of having a lawyer and a signed contract.

By the end of my first year with CQ my part time job had grown to full time and I had sold my hi-fi business. CQ had grown from 72 pages to 128 pages a month and was well in the black. Already I was having a hint of major problems to come though. I had to use every strategem at my command to get the bookkeeper to pay for articles published . . . and as far as being reimbursed for business expenses . . . haw! This was finally solved, for a while, when I decided that I just couldn't run a booth to sell subscriptions at hamfests and conventions all at my own expense at the low salary I was receiving.

My ability to sell subscriptions had brought in quite a bundle and rather than lose this entirely they offered to let me take my expenses out of the receipts if I would continue to go to conventions.

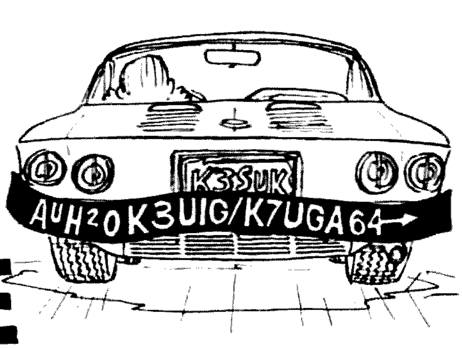
I was having such a good time as editor of CQ that I managed to largely overlook the growing problems that were facing me. I was quite annoyed at the enforced and strict editorial policy I had to live with. Advertisements were accepted from companies that I felt were not reliable. Article payments lagged more than ever. Many authors had to wait from one to three years for payment after submitting their articles. This made it so that I had a hard job getting any good articles and I had to pay for some of them out of my own pocket in order to get them written.

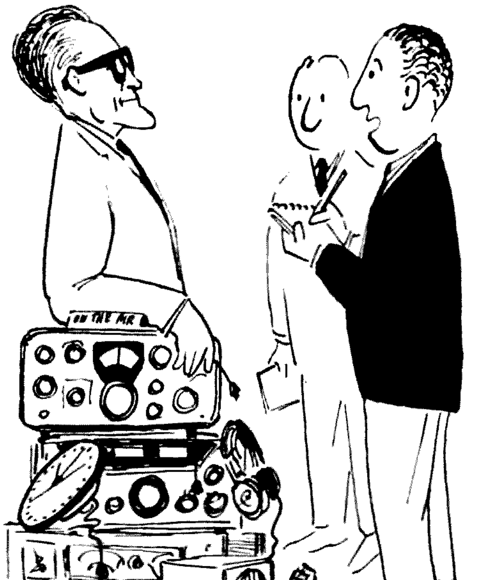
Late in 1959 things came to a head. There were many factors that swung the balance. On the money side there was the fact that I had had one small raise in the five years that I had been there, while CQ was obviously prospering well. Cowan had retired to a 56 foot yacht and his two sons were trying to run the business. I was owed over $5000 in expenses over a period of three years and royalties on the many books I had prepared for them. I have a signed statement still around here for over $2000 of the royalties which were never paid.

Add to all this the miserable situation that developed over the International Amateur Radio Convention. New York had not had a ham convention in over ten years so I went to work and sold Cowan on the idea of backing a convention. He liked the idea and I then went to the local clubs to get their moral and working support. They wanted to know about the financial end, naturally. Cowan made what sounded like a reasonable deal and things started to move along. Then I began to hear rumors. I could see that things were taking

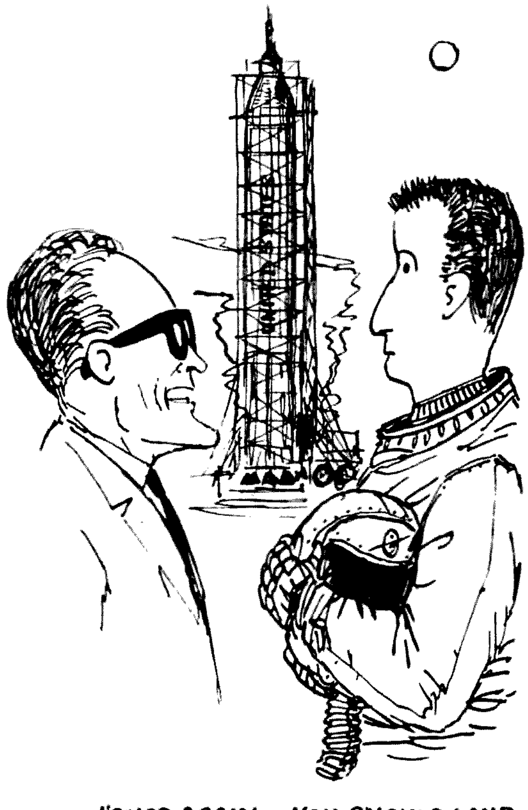
(Continued on page 83)

A HAM IN THE WHITE HOUSE ?





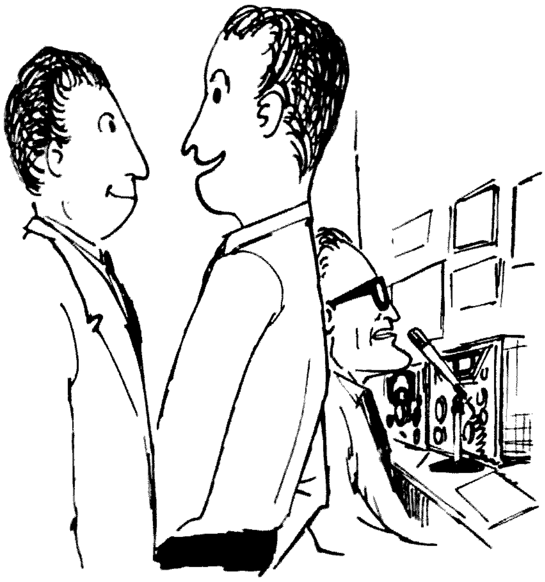
"MR. PRESIDENT... WILL YOU CONTINUE MR. JOHNSON'S EFFORT TO CUT DOWN ON THE WHITE HOUSE ELECTRICITY BILL?"



"ONCE AGAIN... YOU SHOULD LAND AT 0935... GIVE ME A CALL AT 0940 ON 7036 KC... THEN WE'LL TRY 20 AT 0950 ON 14.036... THEN ON 15 AT 1000 ON 21.036 ... RIGHT ON UP THRU THE BANDS ... SEE YOU NEXT THURSDAY... AND DON'T FORGET TO QSL..."

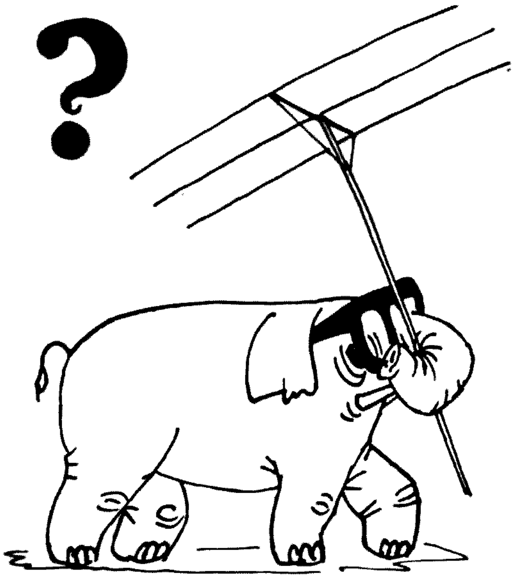
Wayne Pierce K3SUK

"EVER SINCE HE GOT IN THE WHITE HOUSE, HAM RADIO IS REALLY THE BIG THING... I'VE FLUNKED THREE SENATORS, TWO REPRESENTATIVES, AND A GOVERNOR SINCE MONDAY..."



"IT'S NICE TO KNOW THAT IF THE 'HOT LINE' TO MOSCOW GOES OUT OF ORDER, THERE'S ALWAYS TWENTY METERS..."

A HAM IN THE WHITE HOUSE ?

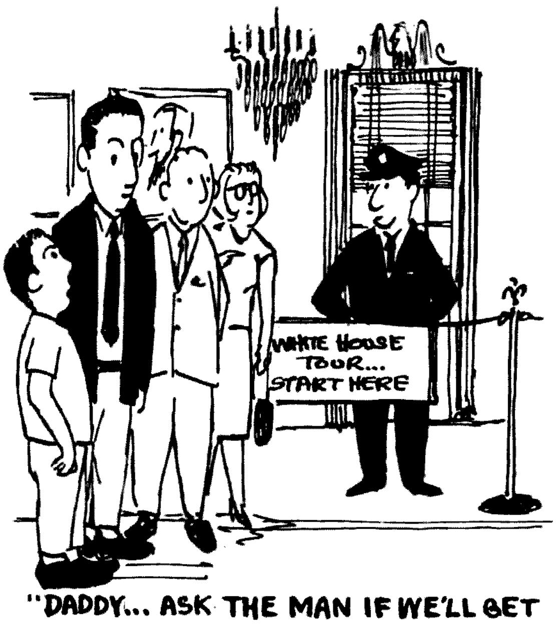


"MR. PRESIDENT... THERE'S SOMEONE OUTSIDE TO SEE YOU ABOUT SOME TELEVISION INTERFERENCE OVER AT THE RUSSIAN EMBASSY..."

A HAM IN THE WHITE HOUSE ?

"DEAR... ARE YOU SURE IT'S ALL RIGHT TO CALL THE PRESIDENT 'OLD MAN' ?"

"HOWEVER, DIPLOMATIC RELATIONS WILL BE RESTORED IMMEDIATELY AFTER THE QSL CARD ARRIVES IN MY OFFICE..."



"DADDY... ASK THE MAN IF WE'LL GET TO SEE THE RIG... "

"SORRY, SIR, BUT I CAN'T FIND ANY FCC RULING ON A PRESIDENT BEING ELIGIBLE FOR A TWO-LETTER CALL..."

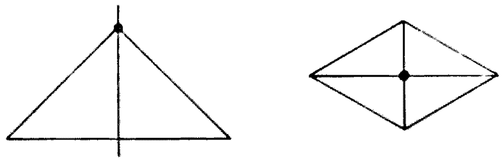
Francis McDonough W3PMV
1226 Clairhaven St.
Pittsburgh 5, Pa.

The TV* Antenna

A Compact full size 20 Meter Beam with increase in height bonus

Have you just not quite enough antenna space? Do you desire a higher antenna without the added weight and expense of a taller tower or mast? Are utility lines, trees, etc. an obstruction to propagation? This antenna may possibly be a solution.

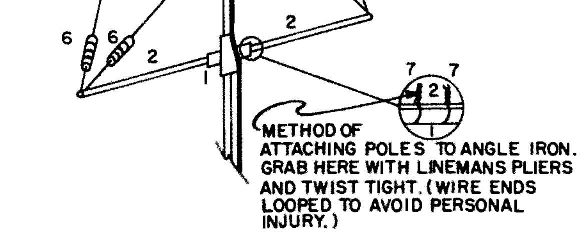
A glance at the sketches A and B will show that 33 feet of wire can be accommodated within a 24 ft span by raising the center approximately 12 ft, giving an average height increase of 6 ft. Horizontal separation of antenna, parasitic by 12 ft at the centers, and bringing the ends in closer, creates an average spacing of 6 ft, approximately .1 wave at 14 mc.



A B

Construction

A hole is drilled in the center of each piece of angle iron to accommodate a one quarter inch (or larger) diameter nut and bolt. The pieces of angle are placed back to back to form the "X" and bolted tight. Additional support is not essential because when the antenna elements are mounted and secured, it will stabilize the array. Two horizontal 12 ft poles are then secured to one section of angle iron using galvanized iron wire as clamps, three clamps for each pole. The poles should first be wrapped with a layer of friction tape where the wires go around. The vertical 15 ft pole is then mounted to the angle using five clamps of iron wire, and when it is secure, the last 12 ft pole is lashed (at its center) to it (horizontally) three feet down from the top, but at right angles to the bottom hori-



Front view Top view

Oblique view

1. 2 pc angle iron (1" stock) ea 2 ft long (1/16" thick)
2. 3 12 ft bamboo poles
3. 1 15 ft bamboo pole
4. 35 ft #14 copper wire (ref.)
5. 33 ft #14 copper wire (ant.)
6. 5 small insulators
7. Galv iron wire (guy wire)
8. Misc pc #14 copper wire
9. Plastic clothes line 7 or 8 ft.
10. Roll friction tape
11. ½" or 5/16" nut ang bolt ½" long

* T shape structure; inverted V elements.

zontal poles. Here again a layer of tape is used over the poles, and several pieces of galvanized iron wire wrapped around, criss-crossed to secure well.

A support strut of plastic clothesline is used to prevent the sag of the top horizontal pole caused by the weight of the antenna and coaxial line. Tie a knot at each end of the plastic line, lay it along the pole (center of line at center of pole), wrap friction tape around line and pole at the knot, then secure with a piece of wire wrapped around on top of the layer of friction tape (per top insert sketch 3). Do this at each end of the line. The center portion of the line is wrapped with a layer of friction tape, and raised enough to keep the pole straight; secure line to vertical pole using a piece of wire.

Now to mount the antenna and reflector: With the structure placed so the horizontal top pole's heavier end up attach the center of the 35 ft reflector element to the end of the pole on the ground by means of a loop of copper wire tightly wrapped and twisted, then attach the ends of the reflector element to the ends of the horizontal poles at the base of the structure lying on the ground in similar manner. (Wrap tape over ends of poles wherever wires are attached).

Flop the array over and secure the center of the antenna element to the thick end of the upper pole, and ends of antenna to lower poles. (Similar manner as reflector).

The antenna and reflector end insulators are actually secured about a foot in from the ends and the element ends are left "hanging." Short pieces of wire or plastic line may be used as end supports from the insulators to the poles.

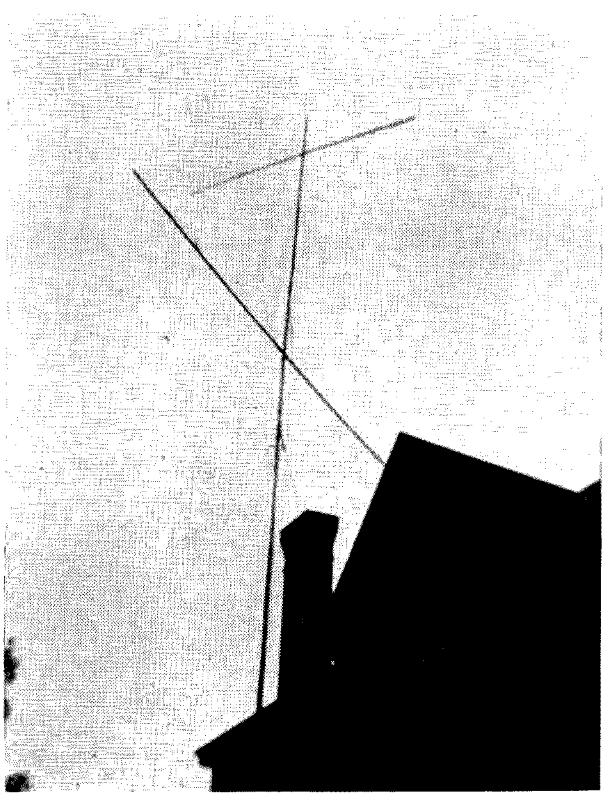
Connect coaxial feed line (50 ohms) to center of antenna, tape along poles where convenient.

The array is secured to a one inch pipe, top section of the mast* by means of five clamps, consisting of two sturdy 1½ inch hose clamps and three galvanized wire clamps, first wrapping the mast with some friction tape, so that when the angle and mast are clamped tight, the chance of wind twist is nil.

I recommend painting the iron and using linseed oil on the poles for greater durability. If desired, fiberglass rod arms may be substituted for the horizontal poles, and heavy wall aluminum tubing for the vertical pole. A standard TV antenna rotator may be used for remote control.

Results speak for themselves. DX stations QSO'd on 20 Meters were ET3AD, VQ8BL

* Dec 59 QST page 28 "Fold Over Mast"



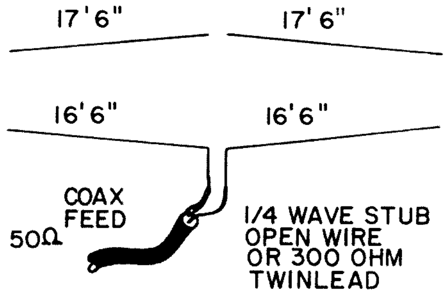
AC4NC KC4USN * YS1MS * W5NAX/EAØ * VQ9HBA VR3L KS6AM UM8FZ 5U7AD ZL4GA JA7AD CN8MB 6Ø1MT UAØKID VK5ZL and dozens of Europeans and So. Americans. (from July 61 to July 62 running 300 watts to homebrew xmtr, average city location) The SWR is 2:1 at 14,000 and 1.3:1 at 14,300 kcs.

The front to back and side ratios are not what one would obtain if a horizontal antenna were used, as there is an amount of vertical polarization present, but the major lobe is higher above the ground than would be obtained using a regular beam or ground plane antenna atop a 35 ft mast, which was the main purpose of this project.

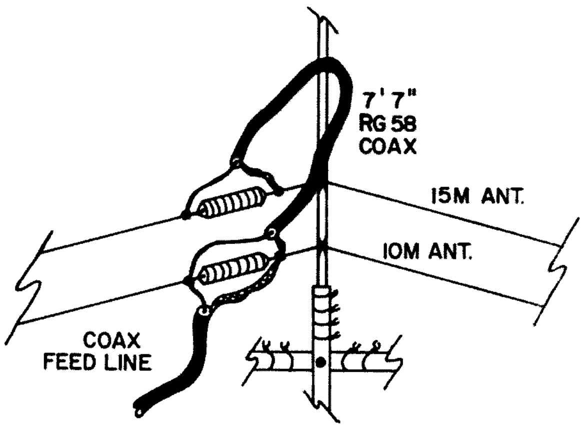
Adding 10 and 15 Meter dipole antennas

Desiring to operate also on the 10 and 15

* SSB



2 ½ waves in phase driven elements
2 refectors (one behind each driven element)



meter bands, the author included antennas for these bands on the same structure used for the "Compact 20 Meter Beam."

The center of the 15 meter dipole is mounted to the vertical bamboo pole about a foot above the angle iron, the ends secured near the ends of the horizontal lower poles. The 10 meter dipole is spaced six inches below the 15 meter antenna by means of a half dozen or so feeder spreaders. Dimensions are 22 ft and 16 ft 6 in of #16 copper wire for the 15 and 10 meter bands, respectively.

Feeding both antennas is accomplished at the centers by means of a single coax line (RG58) and a decoupling stub of 7 ft and 7 in RG58/AU between the antennas. (Without the stub, the SWR is not satisfactory). It is important that the feed line goes to the 10 meter antenna *first,* then the short coax stub feeds the 15 meter antenna. The stub is folded up and secured against the vertical pole with friction tape.

On-the-air-results indicate normal and satisfactory performance. DX is worked when 15 meters is open, and occasional 10 meter operation results in solid local and short skip QSO's.

Other Possibilities

An idea which occured while building the 20 meter beam was the possibility of converting it to a 10 meter four element beam. Collinear driven elements, (two half waves in phase merely by disconnecting the center coax feed, inserting a quarter wave stub of 300 ohm twinlead for 10 meters (6'6" considering the velocity factor) and feed the coax to the bottom of the stub.)

The 20 meter reflector could be opened at the center and it would then become two half wave 10 meter reflectors. The author experimented with this arrangement, making swr check which turned out very satisfactorily, almost 1:1 on 10 meters. However, being primarily interested in 20 meters and DX, the 4 element 10 meter beam was forgotten due to current band DX conditions. But here may be some food for thought for some of the VHF enthusiasts who may desire to "homebrew" antennas by altering the dimensions to suit the band desired.

I'd be interested to hear from anyone who may string up the 2 element 20 meter beam and 4 element 10 meter beam on the same framework. Also, if anyone goes to the extent to make field strength measurements of the 20 meter antenna alone and makes a graph indicating the actual radiation pattern, I'd be interested in the results.

. . . W3PNV

Letters

Dear Wayne,

I have been keeping up with the various controversies in 73 and QST. I suppose I don't have to tell you to keep up the good work and keep needling the QST-boys, they need it! This new "incentive licensing" is a double cross if there ever was one. You mentioned that there is a danger that we might lose portions of our ham frequencies. I would like to go one step farther and say that practically speaking 40 and 80 are one big mess and are lost out in the Pacific area. 20 meters is going also. I might add a plug for the U. S. operator. Whenever I tune to 20 meter CW invariably the nice clean, smooth CW signals come from the States. The same goes for AM and SSB. If you want to hear lousy signals just come out here and get an earful and you will wonder where the QST-boys got the idea that the U. S. hams are a bunch of lids.

Father Ted **K9TXM/VK9TG**
New Guinea

Dear Wayne,

I have been following the growth of the IoAR and I hope it does a good job as the ARRL did many years ago in defending the rights of the Radio Amateurs. It seems they are getting out of hand and needs to be controlled as the F. C. C. did need to many years ago! Enclosed find $10 for the membership (I hope they accept foreign members).

I know how things can get when they are out of control as I live in a country where that has happened. Simply there is no control on the radio amateurs. They can run up to ten kilowatts P. E. P. and they are not controlled or put off the air. Most AM hams run 1.5 kw and sometimes twice that. At least 30% of the hams do not know how to tune their transmitter because they can get a license by just filling a petition to the office that gives the licenses. There is not examination to take (neither written nor code).

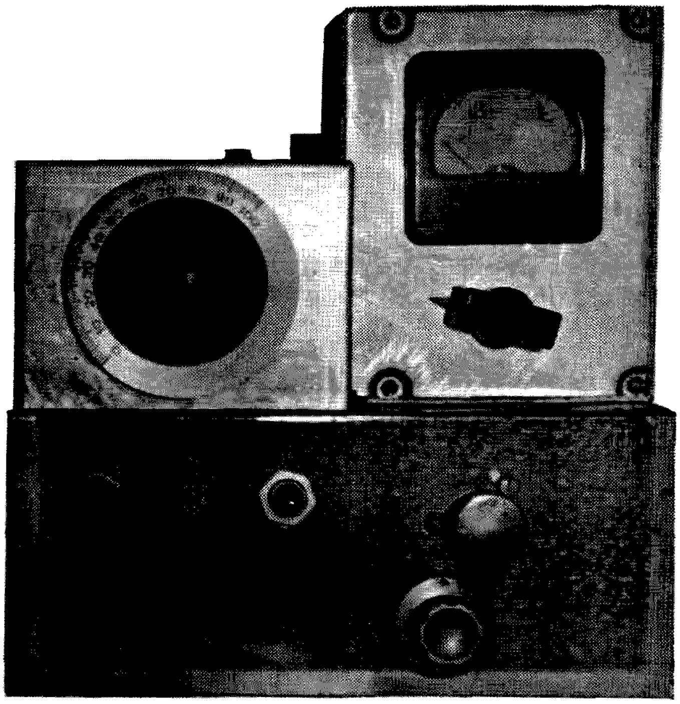
To point out how well this office of "Control de Radio" works there is a broadcast station whose assigned frequency is 825 kc plus or minus 20 cps and that station is operating on 822 kc, 3 kc lower. The office has received reports of the change of frequency from an F.C.C. monitoring station and the broadcast station was advised ten months ago of the "small" discrimination of their operatng frequency but they are still on 822 kc and advertising "Radio Titania, 825 kc"!

On the ham vhf bands, the only thing you can hear is commercial stations (some with ham calls). Most of them are used to communicate with farms or with taxis. There are more than 20 of these on six meters and many more in the two meter band.

Either too much control or too little, as here, in Costa Rica, is bad as you can see therefore I hope the IoAR does a good job.

TI2NA, Eric Roy
San Jose, Costa Rica

A Simple 160M Rig



Geoarge Thurston W4MLE
2116 Gibbs Drive
Tallahassee, Fla.

Opening 160 meters to amateurs in every state should stimulate a lot of activity on this "new" band this winter, even though power in many states is limited to 25 watts at night.

"Top Band" has long been a favorite of those who enjoy stable conditions, don't object to a little QRN, don't like a lot of QRM, and enjoy hamming in most of its phases. The sun spot cycle being where it is, DX is more and more to be found on "Top Band" even with severe power limitations.

Building gear for 160 is an unmitigated pleasure.

Low power means inexpensive parts, "stolen" in many cases from discarded BC and TV sets.

Low frequency means un-critical layout, uncritical parts selection and easy trouble shooting.

When 160 was opened in Florida, I found myself with a receiver but no transmitter.

The trusty old 6146 is an easy tube to coax power from, even at low plate voltages, so that became the tentative choice for a final.

The 6AH6 makes a good vfo. And a 6CL6 was available as a buffer.

This was to be primarily a CW rig, so many little niceties like one-switch spotting, time-sequence grid block keying and clamp-tube final protection were design "musts." Modulation was to be added to the finished unit later, so provisions were made to incorporate this feature without additional changes.

Spotting

Non-swish spotting is provided by a dpdt switch on the panel which kills the final plate and screen voltages while keying the oscillator and buffer.

Drive Control

A wire-wound pot permits adjusting the driver screen voltage from 250v to zero from the front panel. This gives proper values of grid current for the final.

VFO

There are a couple of unusual features about the rig. One of them is the vfo. It operates in the broadcast band.

There are many choices available for suitable coils for the purpose. You can always rob an old BC set of its local oscillator coil. This is then tuned in the vicinity of 825 to 1000 kc by padding it with proper values of capacitance—about which more later.

Several circuits are used in BC oscillators. The two most common are the Colpitts with a tapped coil, and the tptg type shown in the diagram. The tptg seems to be most common. Either can be used, but the tptg is to be preferred in this rig because of its better isolation from the plate load in this electron-coupled arrangement.

Another possible coil is highly desirable, if it is available, because it comes completely shielded. That's the bfo coil from the ARC-5 receiver which covers the range 1.5 to 3 mc. these receivers are not recommended for serious reception on 160 because they're broad, and therefore susceptible to severe loran interference—not to mention amateur QRM.

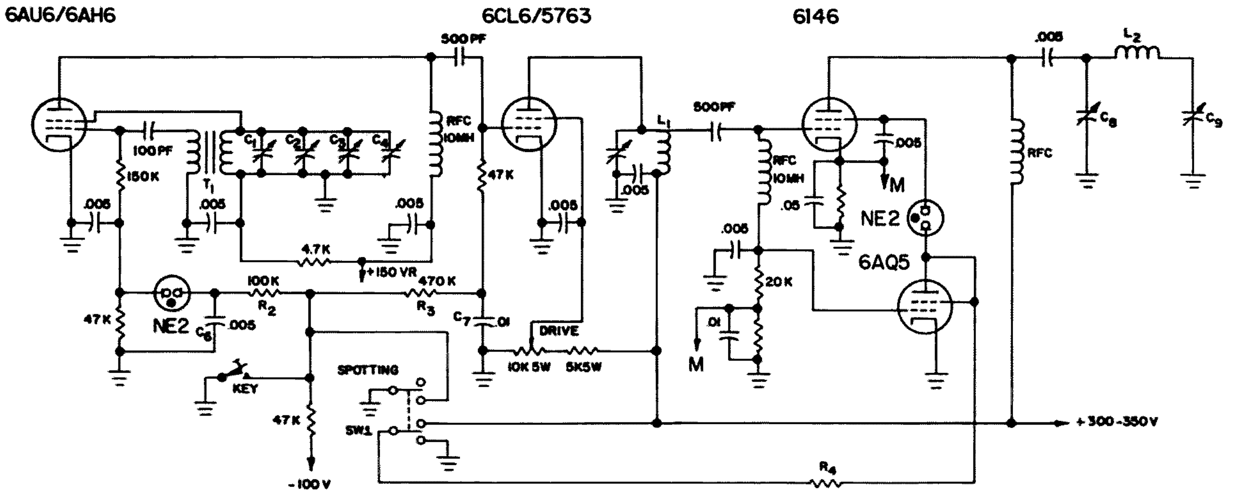


FIG. 1

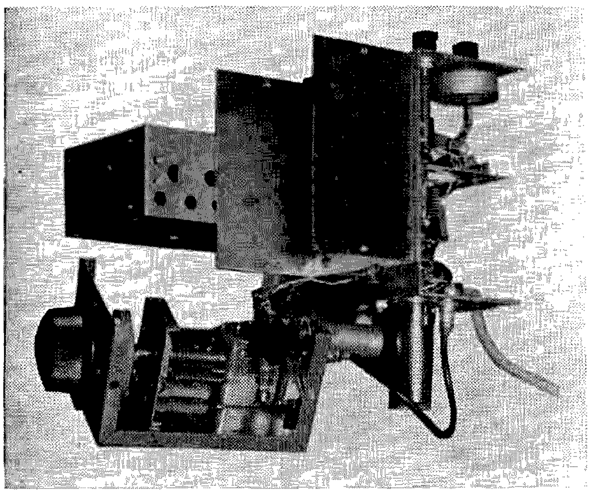
But the bfo coil is a beaut.

Like all the other bfo coils in these receivers, it is enclosed in a small aluminum can and contains a small air-variable padder, in parallel with a button-ceramic fixed padder. The difference is that in this receiver, the *if* is 705 kc—very close to the range we want.

Take off the shield can and remove the button-padder by snipping a lead or unsoldering it and removing its mounting screw. This leaves only the air-variable across the coil. Replace the shield can and mount the unit in the vfo.

The capacitance is built up again externally by connecting *air* variables in parallel with the coil at its terminal lug on the can. They can be screw-driver adjusted APC type for the most part. But while you're stripping that old ARC-5 receiver (any ARC-5 receiver), carefully removed the little "input tune" capacitor from the front panel, where it served as the antenna trimmer. Hook it in parallel with the other padders. It then becomes your calibration trim adjustment.

The vfo tuning capacitor is also an APC-type with a shaft designed for a knob. Remove all the rotor plates except two. They should both be "inside" plates—that is, when meshed, there should be a stator plate on both sides of both rotor plates.



All the air variables are mounted firmly to prevent mechanical vibrations from affecting them. They're connected in parallel and wired into the circuit as shown. This procedure should be followed whether the ARC-5 coil or a BC coil is used.

Wire the rest of the vfo circuit and apply 150 volts from a regulated source. Leave the bias supply off for preliminary adjustment. Some coils may refuse to oscillate until connections to *either* the primary *or* the secondary (not both) are reversed.

Set the main tuning dial for the low end of the segment to be covered (max capacity). Set the calibration trimmer at half-capacity.

Listening with a receiver at the low edge band marker, adjust the air padders until the signal appears. The tuning capacitor should now cover a 25 to 50-kc segment of the band —depending on which end you're tuning. The narrower coverage will occur at the low edge of the band where more padding capacity is required.

The 6-1 reduction dial drive makes this bandspread very easy to handle.

Keying

The time-sequence keying circuit is a direct steal from the Heath Apache transmitter. It works with elegant simplicity and results in a beautifully keyed note.

With key up, bias voltage is applied to the grid of the driver stage and, through the NE-2, to the grid of the oscillator, cutting both off.

When the key is closed, the bias voltage is removed. Almost instantly, the neon lamp extinguishes and the vfo oscillates. However, capacitor C-7 has been fully charged and it must discharge to ground through the 470 k resistor R-3. This time constant is much longer than the time constant of R-2 and C-6, so the buffer does not "turn on" until the oscillator is already on. Thus, the initial click does not get on the air.

When the key is opened, C-6 begins to recharge through R-2 and C-7 begins to recharge through R-3. Since the R-2/C-6 time constant is shorter, the vfo would cut off before the buffer—except for one thing.

The NE-2 is an open circuit until it fires. And it won't fire until the potential across it exceeds 50 volts. By the time C-6 has charged high enough to fire the NE-2, C-7 has charged up and has already turned off the buffer. So the "break" click doesn't get on the air either.

Clamp tube

The initial model relied on the 6AQ5 alone to hold plate dissipation of the 6146 down. However, idling current exceeded the dissipation rating of the tube. The use of a voltage regulator tube in the screen lead is fairly common. With only one small tube to control, and with a screen current of about 10 ma maximum, the NE-2 serves the same purpose admirably, occupying virtually no space and representing a 10-cent investment rather than the cost of the tube and socket.

Coils

The coils—for both the buffer and the final—were wound on parafined cardboard forms taken from an old surplus receiver. They're air core, about half an inch in diameter.

About 60 to 70 turns of "scramble wound" enamel #30 wire in a winding length of half an inch will resonate on 160 meters with 150 to 250 mmfd of capacity.

Resonance should be checked with a grid-dip oscillator if possible. FCC takes a dim view of amateur operations in the broadcast band.

Buffer input from the vfo is in the range of 900 to 1000 kc. Buffer output is in the 160 meter band. The final works straight through.

Output Circuits

Choice of output circuit will be determined to some extent by the kind of antenna you'll be feeding. If you're an antenna farmer with a 160 meter half-wave doublet available, use a conventional pi-tank designed for feeding 70 ohms or so.

If you're end-feeding a handy hunk of

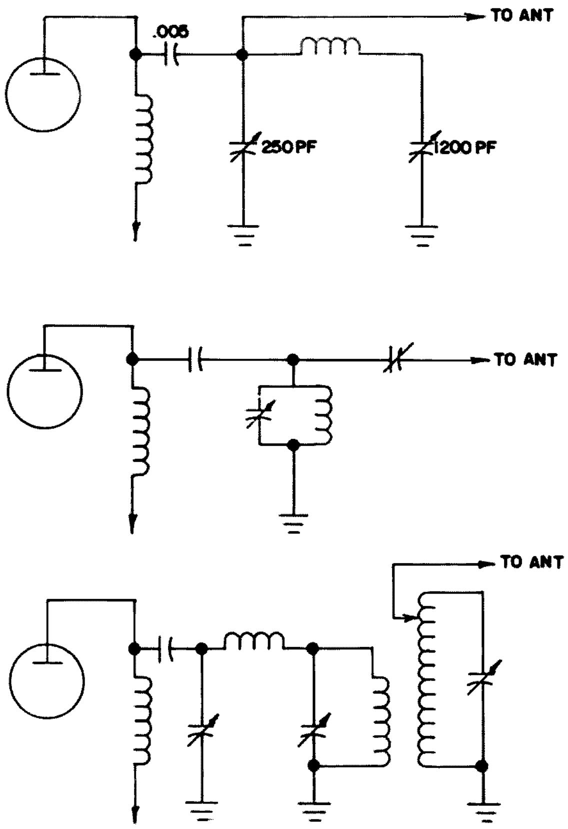


Fig. 2. Alternate output circuits.

wire strung around the back yard, you'll need something else with which to feed the thing. Feeding the 40-meter doublet with the feed line tied together comes in the category of "random" antennas.

The ARRL Antenna Handbook has a fairly extensive discussion of 160-meter antennas and the means of feeding them.

One of the various alternative output circuits shown in the accompanying diagrams will put rf into almost any piece of wire which is capable of putting out a 160 meter signal.

Modifications

The tube lineup is far from sacred. With appropriate changes in electrode voltages and circuit values (mostly grid leak resistors and screen resistors) where necessary, a tremendous variety of tubes would work well.

The buffer could easily be a 6AG7, 6F6, 6V6, 6AQ5, 12A6, 5763 or such.

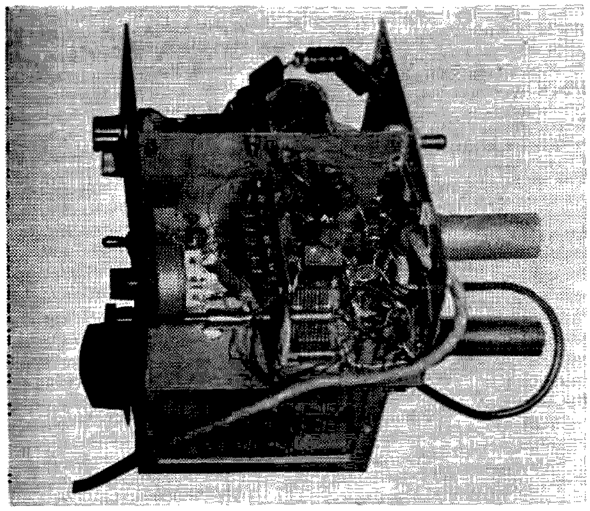
The final could easily be a 2E26, 807, 1625, 815, 6L6, 1615, 829-B, 832-A or such.

The value of resistor R-4 must be computed for each tube and for each power supply voltage. It should give the correct value of screen voltage for the tube being used.

Modulating the Rig

The modulator was omitted from this discussion for several reasons.

The most important is that I haven't built



one. However, it is very easy to provide modulation.

If phone-and-CW operation is desired, a few modifications in the switching arrangement must be made.

The send-receive switch should actuate relays to accomplish the multiple switching functions—or a two position rotary switch with multiple poles may be used since power levels are low.

For CW operation, the transmitter plate voltages are applied at all times. Closing the key puts you "on the air." Modulator plate voltages are "off."

For phone, the modulator and transmitter plate voltages are applied simultaneously, and the key line is grounded.

If phone-only type operation is required (why should anyone want to miss half the fun?) the bias supply and keying circuit may be omitted.

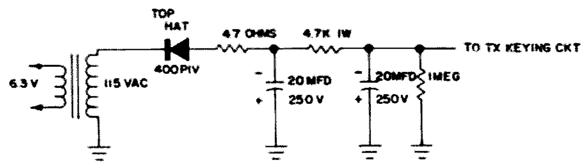


FIG. 3

Summary

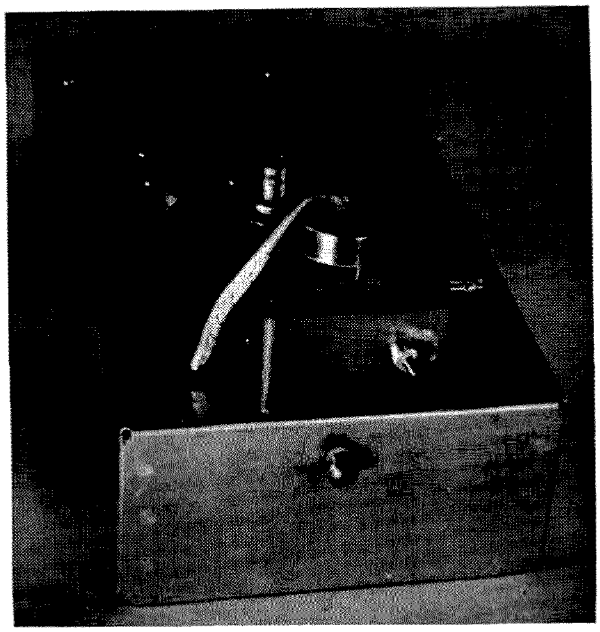
Initial results with this rig have been excellent. Using a 200-foot random length wire fed at the end, I worked Florida, Georgia, Alabama, Nebraska, Ohio, Maryland, Iowa and Ontario in the first couple of nights of operation. Signal reports ranged from 449X to 589X.

Adjustment and operation have been absurdly simple. The rig required very little initial de-bugging beyond the usual cut-and-try experimentation with such things as coils, tuning ranges and such.

Total cash outlay? The $2.18 for the 6AH6.

. . . W4MLE

432 mc Preampliter Low Noise (Very)



Jim Kennedy K6MIO
2816 E. Norwich
Fresno, Calif.

Photo credit: Joe De Young WA6CQL

Most people who have had occasion to work with UHF are aware (in many cases, painfully) of the severe inadequacy of the conventional crystal or tube mixer type converters commonly used above 400 mc.

The most expensive diode mixers will, under the best of conditions, yield perhaps a 7 or 8 db noise figure with the more common types (1N82, 1N72, CK710, etc.) operating in the 15 db region. Noise figures even on the better tubes such as the 417A or 6AM4, run in the neighborhood of 13 db at 420 mc. These same tubes used as preamplifiers will do a little better, but still, 7 db is about all that can be expected.

This is alright if you are only interested in local work, but if you are seriously interested in working some DX, something will have to be done. With all this noise being produced it is obvious that many weak signals will go completely unheard. Reducing the noise figure of your converter can produce very dramatic results. A signal that is 7 db under the noise with a 15 db noise figure will be 3 db or more[1] above the noise with a 5 db noise figure.

The problem, then, is how do you reduce front end noise? One answer to the problem would be to employ a parametric amplifier. A paramp will provide more than sufficient gain to override converter noise and the noise figure should be under 2 db. However, paramps have some distinct disadvantages. They are difficult to tune up and their operation is likely to be very unstable unless considerable attention is paid to mechanical stability, voltage regulation thermal stability and low voltage regulation, thermal stability and low features, paramps have inherently narrow bandwidths. At 420 mc the bandwidth will be in the neighborhood of 100 kc. At 1296 mc or higher the paramp or the far more sophisticated (!) maser, seems to be the only answer at the current state of the art. At 420 mc, however, there is one other alternative, the 416B planar triode.

The 416B is a microwave triode commonly used by the telephone company in their 3 gc microwave gear. In this equipment it is used as a frequency multiplier and transmitting amplifier with outputs running in excess of 1.5 watts.

Aside from its transmitting applications, the 416B offers great advantages as a receiver amplifier. Primarily, it has a nominal G_m of 50,000. As a result of its high G_m this tube is capable of very high gain and very low noise.

It will be noted from Fig. 2 that there are actually two cathode connections made to the tube. The connection made to the base pin is for dc while rf is applied to the shell of the tube which is coupled through a built in capacitor to the cathode. The grid connection is the threaded ring and the plate, of course, is the tip on top.

The only major drawback in using this tube is that if the plate voltage and plate current setups used in transmitting applications are duplicated in a receiving amplifier, forced air cooling of the tube is required.

[1] New Thresholds in VHF and UHF Reception, Bateman and Bain, QST, January 1959.

It is possible, however, to circumvent this difficulty, if desired, by lowering the plate voltage and fiddling with the grid bias. This will reduce the heat dissipation to a point that can safely be handled by convection cooling.[2] This is done at a slight sacrifice in amplifier performance but the loss of gain is not serious.

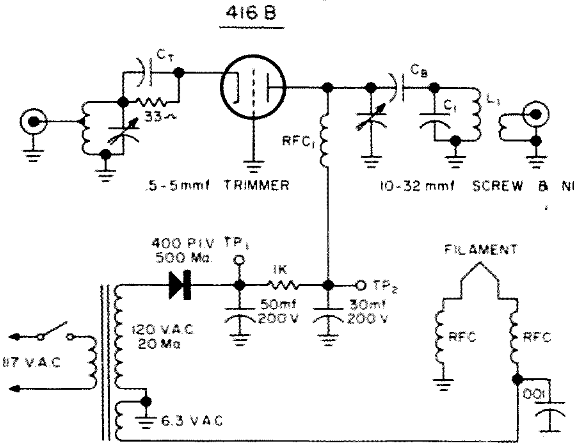


Fig. 1—Schematic diagram. C1L1 Coaxial Tank, CB Plate Blocking Capacitor (see text), CT built in Cathode Capacitor (see text), RFC1 formed by having B+ lead inside plate line, RFC2 filament rf chokes (see text).

Construction

One of the primary considerations in the construction of almost all UHF gear is mechanical stability. In order to comply with this standard, a rigid ¼ wave trough line was chosen as the plate tank circuit. The trough line offers most of the advantages of a regular coaxial tank and is somewhat easier to construct and lay out.

Again, in the interests of mechanical stability as well as simplicity, it was decided to insulate the line from dc with a plate blocking capacitor, allowing the cold end of the inner conductor of the plate line to be grounded for dc as well as rf.

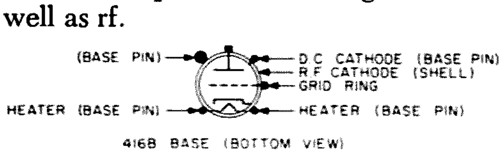


Fig. 2—Base diagram.

Plate Line

The trough is constructed of 1/16 inch brass sheet stock. The trough is formed by 5 separate pieces of stock. If one had access to brake that would make clean folds in this size stock, the trough could probably be made from one piece of stock.

The various parts of the trough are cut, drilled and tapped according to the templates in Fig. 3. The larger holes were made with the aid of a burring reamer.

The trough is now partially assembled. The side plates are soldered to the top plate with a propane torch. A vise and small "C" clamps are helpful. The side plates should be soldered to the bottom rather than the side of the top plate.

The end plate at the cold end of the trough may also be soldered in place.

When applying torch heat in the vicinity of previously soldered joints a wet paper towel or rag wrapped around the previous work can save much grief.

The grounded portion of the inner conductor is made of a 4⅜ inch length of 5/16 inch O.D. brass tubing. The ungrounded portion of the inner conductor is made of a 2½ inch length of 3/16 O.D. tubing.

A plate connector made from a small piece of 3/16 inch tubing is soldered to the 3/16 inch portion of the inner conductor. It should be attached about ¼ inch back from one end of the line. A rat tail file can be used to make notches which are cut in the other end. The tabs thus made are bent in to form a snug-fitting connector over the plate pin of the tube.

At the same end of the inner conductor a small circular piece of shim brass is soldered to cover the open end of the tubing. This forms one of the plates for the tuning capacitor.

One end of the B+ lead is soldered to the inside of the other end of this portion of the inner conductor.

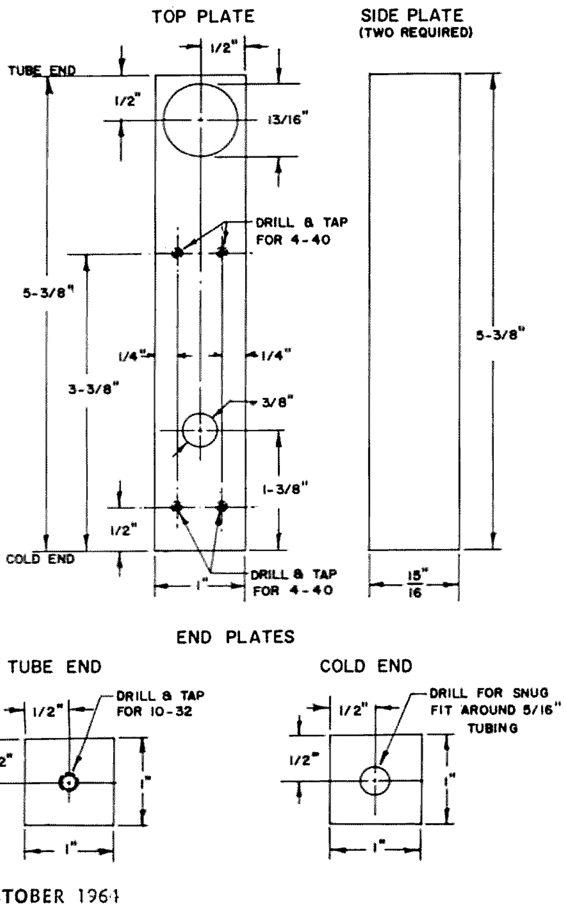
A piece of ¼ inch thick plexiglass is obtained from a hobby shop and cut to ⅞ inches square. A hole is drilled in the center for a snug fit over the grounded portion of the inner conductor. Two holes are drilled in one edge and taped for 4/40. These holes are placed ¼ inch each side of the center of the edge and should match the tapped holes at the tube end of the top plate. Fig. 4 should be referred to as a guide when completing the line assembly.

Several wraps of teflon, mylar, or cellophane tape are made over the 3/16 inch portion of inner conductor. Then the tubing, tape and all, is slipped into the 5/16 portion of the line—thus forming the plate blocking capacitor.

At this point it is wise to solder a volume control (not toggle switch) nut over the inside of the ⅜ inch hole at the cold end of the top plate.

A 1¾ inch strip 3/16 inch or so wide of shim copper or brass should also be soldered to the extreme cold end of the top plate. This should be bent over to form the output

TEMPLATES FIG. 3



loop. A female BNC connector should now be mounted in the volume control nut and the free end of the loop soldered to it. Trim off any excess.

The inner conductor may now be soldered in place and the assembly completed, including the 10/32 screw and nut used to tune the line. Be sure not to overheat the BNC connector.

The chassis is drilled similarly to the top plate, except that the ⅜ inch hole at the cold end is reamed so that it clears the circular shirt on the BNC connector. Also, the 4/40 holes are not tapped but, rather, drilled out to clear the screw.

Cathode Line

The main body of the tube is housed in a box. One side of the box was left open when the unit was built in anticipation of the possible necessity of forced air cooling. The box may be closed if desired, though being open seems to have no adverse effect on performance and it provides much easier access to the tube.

The box is formed by cutting a piece of 1/16 inch brass to 2 inches square with a 13/16 inch hole in the center. Another piece 1¼ inches by 6 inches, is bent into a block "U" shape and soldered to the 2x2 plate to form the sides and bottom of the box. A ⅜x40 nut should

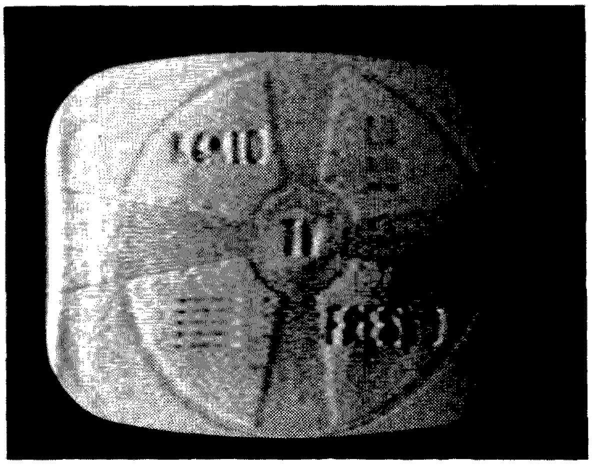


Photo 4—ATV picture without preamp.

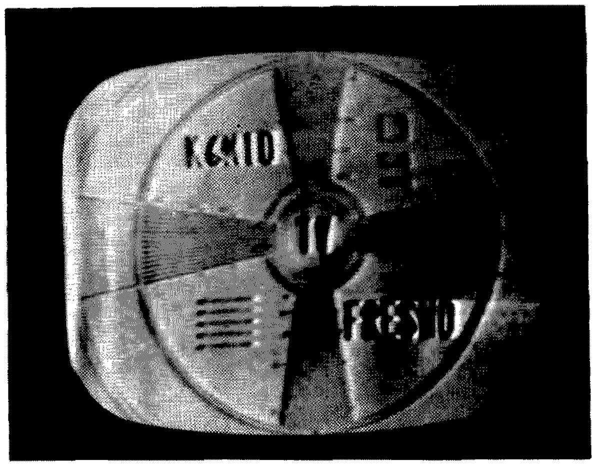


Photo 5—Same picture with preamp—all other conditions unchanged.

then be soldered to the bottom plate over the large hole in the center.

The cathode line itself is a 1-inch piece of copper shim from the bottom of the box to the top (or to the bottom, depending on which way you look at it) of the rf cathode ring. The top end of the line is soldered to a clamp made by forming a strip of copper shim around the tube and using a screw to "cinch" it up.

The input BNC connector is mounted near the top of the side of the box and taps directly into the cathode line very near the tube. A small 5 mmfd piston type trimmer is also tapped at this point and is used to tune the cathode line.

Final Assembly

A hole was drilled in the line end of the chassis to clear the head of the plate tuning screw.

The cathode box is bolted in place and likewise the plate line.

The base pin connections can be made in several ways. First of all, a "trans amp" cavity (more on this later) will provide a socket similar to the one shown in the photographs. If such is not available, connections can be made either by using pins from a broken miniature tube socket or cautiously soldering the leads directly to the tube pins.

The filament chokes were made by wrapping about 15 turns of number 28 wire around 1 meg ½ watt resistors. The exact number of turns is not critical. These should be connected to the filament pins with the shortest possible leads.

Two test points were installed, one on either side of the 1K resistor in the power supply. A voltmeter between these points will read one volt per milliamp of plate current and from one point to ground will read plate voltage.

[2] Frank Jones, **VHF For The Radio Amateur**, p. 140.

Tune Up

The 416B is installed, and plate and filament voltages applied to the amplifier. If nothing smokes inordinantly and the plate current is in the 7 to 11 ma range, connect the amplifier to your converter and antenna, and find a signal to tune up on.

It will be found that the input circuit is very broad and the peak achieved in tuning it is slight.

Conversely the plate line Q is quite good and the tuning is much sharper. Even so, the bandwidth seems quite sufficient to accept the better part of a double sideband TV signal 8 mc wide.

Once tuned up, the amplifier seems to need no special care. It has run many hours with 150 vdc on the plate at 9 ma with no apparent ill effects.

Results

The amplifier exhibited a gain of 15 to 17 db with each of three "reject" tubes tried. A new tube would undoubtedly provide more gain, but 15 db should be sufficient to override all but the noisiest of converters.

Stability was excellent, with not the slightest trace of instability in evidence.

Noise figure measurements are rather difficult to make accurately, particularly under

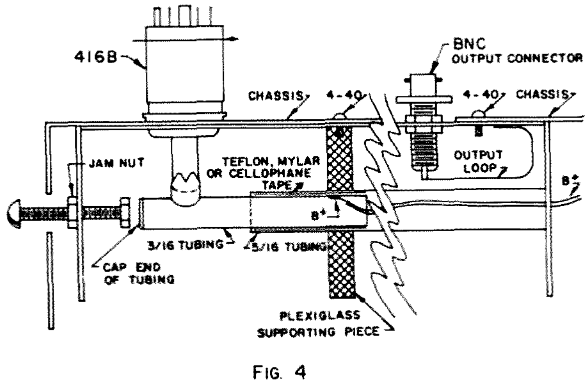


FIG. 4

Fig. 4—Mechanical details of the plate line.

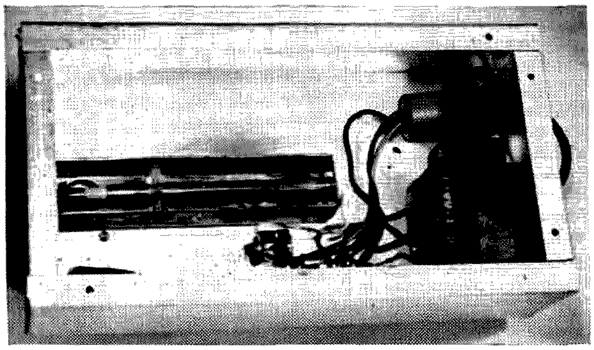


Photo 2—Bottom view of the amplifier showing the plate line and power supply.

any but laboratory conditions. But indications are that the preamp will perform in the 4 db or less region easily. Such noise figures will provide a dramatic difference in most converters. The "before and after" photos of the ATV picture pretty much speak for themselves. The converter used in the pictures was a 1N82 crystal set with a 417A *if* amplifier.

Comments

One problem encountered in a project of this sort is that, outside of the power supply components, most of the parts and materials are not exactly "over the counter items" at most parts houses. However, most are readily obtained with a little digging.

The various sizes of brass tubing are stock items in most hobby shops. The brass sheet stock can be picked up at almost any sheet metal shop.

The ¾ x 40 nut so nonchalantly mentioned earlier is a bit tougher nut to crack (ugh!). Apparently such nuts exist, though they have defied my persistent efforts to locate a quantity source. If you encounter similar difficulty there are several ways to circumvent this problem.

As previously mentioned, 416Bs are commonly used in telephone microwave gear. The various multiplier, mixer, and "trans amp" cavities in which they are used may be butchered to provide a plate with the appropriate thread.

Canvassing of the local machine shops revealed a couple who were willing to machine the thread in a piece of 3/32 or so sheet stock with a lathe. The price quoted was about $3.00.

The jam nut used on the 10-32 screw-tuning capacitor was made by drilling out and taping a piece of the teflon dielectric used in teflon insulated coax.

The teflon tape was also obtained from teflon coax. It is used as a protective wrap between the outer conductor and the outer jacket.

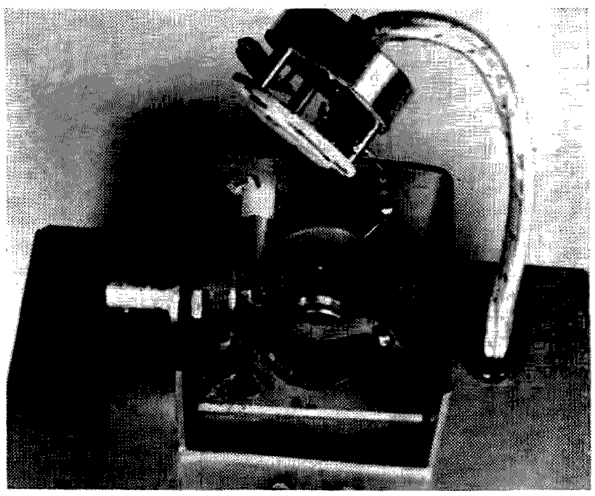


Photo 3—Close up of the cathode box, with tube removed, details of input circuit.

The 416Bs themselves have turned up on the surplus market, but even so are rather expensive. 416Bs (and 416As which may also be used) that have been removed from 3 kmc service often work quite well at 432 mc and it has been my experience that such tubes can be located with a little prudent snooping—generally at no cost at all.

Most serious UHFers, whether AM, CW, SSB, RTTY or TV, will find this preamp more than worth the time, smashed thumbs, burned fingers and minimal financial outlay required.

Many thanks to Joe WA6CQL whose assistance was invaluable in the preparation of this article.

NOTE: You can improve the noise figure by at least a db by increasing the plate voltage to 250 and running a blower on the tube. This results in higher gain, lower noise, and short tube life.

. . . K6MIO

Surplus and Junk Box Special

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The SJS Receiver

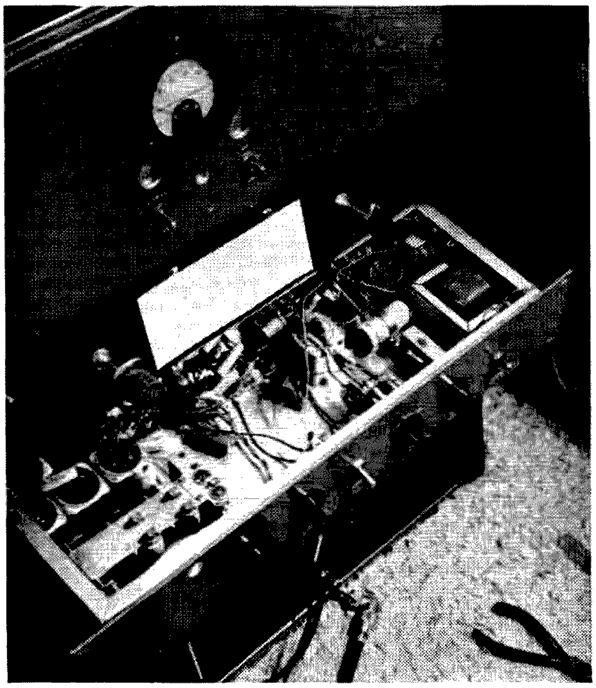
Part 2

In the preceding article, Sept. 64, page 34, I described the overall approach and configuration used in the SJS receiver, with detailed instructions on the tuner/audio unit which is the heart of the rig.

Now, we're ready to proceed with the intermediate converter. This, as its name implies, is a fixed-tuned converter which converts the 7-8.05 mc frequency range down to the 190-550 kc range which the tuner audio unit will accept.

Like the tuner/audio unit, the intermediate converter is built into a 3½ inch relay rank panel. It includes a power supply hefty enough to power all five outboard converters, and switching which connects the proper outboard converter to the input and also energizes that converter.

The intermediate converter itself includes three tubes. A 6BJ6 is used as a grounded-grid rf amplifier while two 12AT7's serve as respectively, mixer and oscillator/output coupler. The rf stage is operated grounded-grid mainly to preserve a low input impedance over a wide frequency range, thus minimizing the number of tuning adjustments required.



190-550 kc tuner

The plate circuit of the rf stage and the grid circuit of the mixer comprise a tunable band-pass circuit which operates just like an antenna trimmer to peak the desired input signal. This circuit also rejects images, keeping the overall image ratio of the SJS at least as good as that of most commercial multi-conversion receivers.

The mixer uses the "like new" circuit described in these pages some time ago. The object was to minimize receiver noise since it was felt that listener fatigue would be minimized if receiver noise were kept as low as possible through all stages.

The oscillator is a conventional Pierce crystal circuit, with low plate voltage to minimize spurious responses. The other half of this 12AT7 was originally intended to drive an S-meter, but was used as a cathode follower to couple the mixer output to the line to the tuner/audio unit when this line appeared to be contributing some birdies because of high impedence pickup. The lack of an S-meter has never hurt operation in the six months this receiver has been in use!

The circuit is extremely straightforward, with the possible exception of the band-pass coupler. Fig. 1 shows all wiring except the filament line. All filaments are connected in parallel, with one side grounded and a single wire running along the chassis to make the bus.

Ready to build it? Let's go!

Start by gathering together your tube sockets, tools, and a 5 × 3 × 17 inch chassis. If you use the same type of transformer I did, you can follow the layout (Fig. 2 and 3) exactly; if you raid the junkbox for a suitable unit, position it in the same area and find your own mounting hole positions. Then drill and punch all other holes, and de-burr them.

Second step is to mount all tube sockets, the transformer, and the converter-power-output sockets. I used single-hole mounting phono jacks for the rf input and output connections, but you can use anything you like which will fit into the space. Whatever you use, they

should be mounted at this stage also.

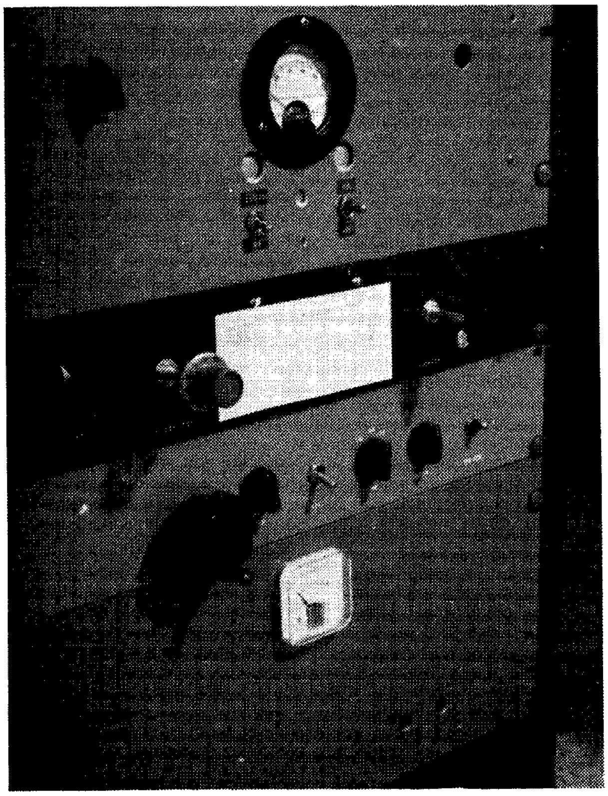
Now wire the filament lines and the power-supply circuits. Temporarily mount the power switch and the pilot bulb on the front side of the chassis while connecting them into the wiring. When this much of the wiring is complete, plug in all tubes except the 5Y3 and see if they light when power is applied. Turn off power, measure resistance from the 5Y3 filament to ground, and if it is not less than 45,000 ohms (total value of the bleeder resistors) after the initial charging surge through the filter capacitors, plug in the 5Y3 and re-apply power. Measure power supply output voltage at the top of the bleeder; it should be between 250 and 300 volts without additional loading. Plug in the OA2 regulator tube and measure voltage at the junction of the two 20K resistors in the bleeder string; it should be 75.

At this point remove power, wait a few minutes to let the capacitors discharge, and take out the tubes so they won't be damaged. Now, wire the power-distribution circuits, and all connections to the tube sockets (make the tube-socket end of the connections to the band-pass tuner and the bandswitch by using short chunks of solid hookup wire. You won't have much room to make the connections after installing the switches and capacitors!).

Next step is to pre-wire the band-pass coupler. I used a small surplus dual 35 mmfd variable made by Cardwell, with 270 mmfd silver micas padding each section for band-spread. However, you can eliminate the four extra padders by using a larger variable (say about 100 mmfd per section) if you can find one in your junkbox which can squeeze into the space. In this case, you would want the padders to be about 220 mmfd instead of 270. Total capacitance required to hit 7.0 mc with the specified coil is about 330 mmfd, not counting the strays.

The coils of the band-pass coupler are made from a single length of ⅝ inch diameter, 16-turns-per-inch prewound stock (Airdux 516). Six turns are removed in the middle of the piece, and turns are removed from each end to leave 14 turns on each coil. The six turns removed space the coils properly for about a 100 kc band-pass, thus minimizing the need to repeak the circuit when tuning over a limited range.

Since the quarters are a bit tight for wiring the whole coupler inside the chassis, I pre-wired the fixed padder capacitors and the coil set to the variable capacitor. The outside ends of the two coils go to the stator plates of the capacitor. The inside end of the rear coil goes

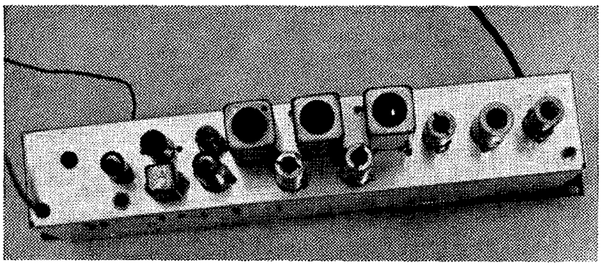


directly to ground, while the adjacent end of the front coil is bypassed with a .001 mfd disc ceramic capacitor. The 2700 ohm decoupling resistor is connected to the bypass point with the shortest possible leads.

Next, the capacitor and associated components are angled into the chassis and bolted down. Be sure the capacitor rotor is properly grounded at both ends; a puzzling parasitic showed up here until this was double-checked and corrected. The front stator connects directly to the plate (pin 5) of the 6BJ6, while the rear stator connects to pin 7 (signal grid) of the 12AT7 mixer.

If you are using the switched padders shown on the schematic, run direct leads from the two stators to appropriate wiper contacts on the bandswitch (which must be mounted for this). If you use a wide-range variable and eliminate these padders, the bandswitch need not be mounted yet.

Connect a coax cable from the cathode capacitor's free end (at the 6BJ6) to the converter switch arm. This cable should be dressed around the inside of the chassis and should be grounded at each end to prevent any stray pickup. Now cut a set of coax cables to reach from the appropriate switch points to the corresponding "input" connectors on the back panel, connect them, and solder to the converter switch. Again, ground the shields at each end. While you're at it, run the leads from the 150 volt and 250 volt sources to the wipers of the converter switch, and from the corresponding switch points to the appropriate converter power jacks at the rear. The converter filament wiring should be checked also, to make sure it wasn't overlooked when the other filament lines were run.



7000-8050 KC converter

You'll notice that no crystal sockets are shown. To minimize space requirements, I soldered short leads to the pins of the three oscillator crystals and connected them directly to the proper switch points on the bandswitch. If this bothers you, you can make up small metal brackets to hold crystal sockets. In either event, connect the 6800 kc rock so that it is in the circuit on position 1, the 7150 kc crystal for position 2, and the 7500 kc one for position 3—and the bandswitch wiring is complete. Double-check to make certain you haven't omitted any connections, and fire up.

With the tubes drawing current, voltage at the mid-point of the bleeder resistor should drop to approximately 50, with 150 still present at the top of the VR tube.

Alignment is simplicity itself. Set the bandswitch to position 1 and connect the intermediate converter's output to a tuner capable of reaching 200 kc (such as the tuner half of the SJS). Feed in a 7 mc signal. You may have to tune around a bit to find it since the 6800 kc crystal may not be on *exactly* 6800 kc. (my unit was approximately 9 kc low). When you have the signal located, turn the peaking control fully counter-clockwise and adjust the appropriate switched padder capacitors for a peak.

Now change the input signal frequency to 7350 kc and the bandswitch to position 2. Adjust the other pair of switched padders for a peak.

Finally, raise the input signal to 7700 kc and turn the bandswitch to position 3. See if you can peak the signal with the peaking control near the full counter-clockwise position. If you can, alignment is finished.

If you are using the bigger-capacitor, no-switched-padders approach, simply make sure you can reach a peak on a 7 mc signal near full counter-clockwise and on an 8.05 mc signal near minimum capacity. If you can't cover the whole range, you need to use a smaller fixed

padder and remove a turn or two from the *hot* (outside) end of each coil; if range is excessive, you can add fixed padding capacitance until 7 mc is at the full-capacity position of the variable.

Since the input impedance of this converter is approximately 100 ohms, don't expect it to perform well on 7 mc without an outboard rf amplifier unless you feed it with a carefully matched, resonant antenna. However, it shows moderate performance when fed with a random length of wire! With any type of matching device at all ahead of it, performance is excellent.

And in the role for which it was designed—matching a VHF converter to the low-frequency tunable *if* strip, its performance is nothing short of sensational.

A word on operating procedure to minimize images. Since the band-pass coupler provides the *only* 7 mc selectivity, and the image frequencies range from 400 to 1100 kc below the desired frequencies, you may occasionally find one. However, if you calibrate the peaking control (or even keep in mind what its approximate position should be for a given signal frequency), you can readily determine whether the signal you are getting is a true signal or an image. I find, for instance, that with the tuner set for an incoming signal at 7200 kc but with the peaking control on the intermediate converter set around 7 mc, I can easily copy a shipboard CW station operating somewhere around 6400 kc. However, when the peaking control is swung up into the proper position for 7200 kc, not a whisper of the shipboard station comes through.

You may also, on occasion, run into a secondary image from strong signals 170 kc higher than the frequency you desire. This is an image problem in the tuner—but again, the peaking control can wipe it out. I frequently copy some of the local kilowatts (operating on 50.-250 mc) at an apparent frequency of 50.080. To do this, I must have the peaking control set at about 7.250 mc so that the full signal hits the tuner. If I move the peaking down to 7080 kc, the image goes away.

So there you have it—the Surplus and Junkbox Special. It's no "ultimate" receiver by any means — I've been doodling designs for another one since before this one was built. However, as I said to start with, it's inexpensive and it does perform well. For more than six months it's been the sole receiver at K5JKX, and in that time (with good converters ahead of it) has never failed to copy any signal audible on similar antenna systems in this vicinity! More than that, I can't ask—especially when the cost is next to nothing! . . . K5JKX

Sideband on 2M
The P + H 2-150

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The introduction of VHF SSB has created new interest in the bands above 30 mc. It's all too easy to get up there and quack with the best of them if you have a low frequency transmitter or transceiver. Even if you don't, a trip to the local ham store will show tables full of the older SSB gear at a fraction of their new cost. Having a Gonset GSB-100 I decided to take one step forward. Being intrinsically lazy I always look to commercial gear.

The P&H 2-150 is essentially a linear mixing device followed by a linear rf amplifier; mixing from 20 meters for a signal in the 2 meter VHF band. All of the features of your 20 meter gear may be had at 2 meters: crystal or VFO control, VOX or PTT, AM CW USB LSB, with similar stability. Two meter frequency coverage will be the same as the 20 meter exciter without changing mixing crystals. More on this later.

A 6EA8 is used as a high stability oscillator and tripler, and will operate on any frequency from 130.0 mc to 133.5 mc. This will permit operation in any segment of the 2 meter band. My unit was supplied with a 43.333 mc crystal (X3 = 130 mc) for operation from 144.0 to 144.6 (with GSB-100). I changed this to 43.666 mc and realigned the unit to 145 mc as most of the SSB stations are above 145 mc in this part of the country, operating upper SB.

The oscillator signal is available at an RCA phono jack on the rear of the chassis permitting the same oscillator to be used for a receiving converter. The design is thus simplified and you have correct correlation between transmitter and receiver calibration. This is quite valuable when using a transceiver.

The 130 mc signal is link coupled to the push-pull grids of a 6360 balanced mixer stage. By adjusting the injection and grid bias, compensation is made for small variations in exciter output.

Exciters with outputs of 5 to 25 watts will drive the unit to full power. A switchable (in or out) internal Pi-section pad is used to attenuate the signal from the popular 100 watt class exciters. Also supplied is a large 3 db pad for AM operation and to correct for large differences in power levels.

Due to passive-screen single-ended injection, no tuning of the 20 meter input is required and superior mixing product attenuation is more easily obtained.

Following the 6360 mixer is a second 6360 used as a class A buffer amplifier. Mutual coupling between the buffer input and output circuits is minimized by shielding and isolation. The buffer plate circuit is overcoupled for further simplicity of operation, to the 7854 grid circuit. This tube operates class AB-1 as the final amplifier with efficiency up to 60%. The 7854 is an Amperex twin tetrode, designed for linear amplifier service at VHF frequencies. The high level rf amplifier circuit is completely shielded within the 15″ wide × 9″ high × 11½″ deep cabinet, with a cooling fan for the tube envelope and push-pull plate tank circuit.

The rf output passes through a harmonic filter to the antenna connector. It is sampled, detected, and filtered for relative rf output readings used in tune-up. Switchable metering is provided for the PA grid current, PA plate current and relative output. The meter scale is calibrated accordingly.

The built-in power supply provides all voltages for converter operation. Separate high voltage, low voltage, and bias supply; all are separately filtered. The PA screen voltage and oscillator voltage is regulated. The mixer and PA bias voltages are variable by pots at the rear of the chassis. Also at the rear of the chassis is a terminal strip for PA cutoff bias which is shorted on transmit. This must be open on receive because the diode noise,

generated by the electron flow through the 7854 under the static current conditions of 50 ma, can be heard in the receiver. I used the external switch of a coax relay with a SPST switch in parallel for spotting with the exciter. The parallel switch is not necessary if you are tuning 14 mc on the receiver.

Tuning and loading is the same as for any class AB-1 linear amplifier used on the low frequency bands. It should be operated into a load with a low of SWR as possible. Retuning of the converter is normally not necessary unless large frequency excursions are made.

Input and output impedance is 50 to 70 ohms. Plate power input to the final amplifier is 175 watts PEP SSB, 165 watts CW, and 90 watts linear AM.

Construction is heavy duty throughout. Liberal use of inter-stage shielding below chassis, and better than average wiring technique is employed. The chassis is copper plated steel. All parts are arranged to minimize any difficulty in trouble shooting, should the need arise. After long hours of operating, the cabinet is only a few degrees above ambient due to the 200 cu ft/per min. of air flow from the cooling fan.

At first glance the instruction manual looks a little thin. True, it is not artistic, but it does contain the theory of operation, interconnection diagrams for high and low power transmitters and transceivers, alignment instructions, mixing frequency crystal chart, and installation and operation instructions. It should pose no problem to those familiar with SSB gear and linear amplifiers.

Also available is the model 6-150 for 6 meters. It is essentially the same as the 2 meter model but has a different tube line-up.

By now you are probably saying "OK so the thing works, why do I need SSB to work my buddy Joe across town?" The answer is that you don't, if you are only interested in working Joe across town, but if you like to try something new, make new friends and still keep the old ones on AM, give this a try. All of the advantages of SSB at the lower frequencies are there. I have increased my range many times over my old 65 watt AM rig, using the same antenna (8 element yagi) and receiver. True, SSB contacts are rather far apart, but when you do make one most of the time they turn into round-tables. With modern VOX this is just the thing for a DX rag-chew. Can you remember the days when you were one of a handful of SSB stations, operating an all AM band, and the good discussions?

. . . K6LOP

The 432'er

Transmitter RF Section

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Melrose, Mass.

Philosophy

If you are only interested in construction, skip these paragraphs. But I assure you, there's plenty of meat here for anyone seriously interested in the amateur UHF art. Or perhaps it should be the art of being a UHF amateur?

The name "432'er" has several implications. The famous "TWO'ER"—low cost, running about a watt or so out, with an SR receiver—has provided me with lots of contacts. Not *my* Two'er though. I never had one. Being a confirmed 2 meter man since 1946, and 2½ meters before that (and 5 meters before that) I graduated up to a Johnson 6N2 years ago. But loads of Two'ers are on the air—immediately identifiable as a rule by that characteristic downward modulation. I even worked a VE1 who was using a 2'er in St. Johns, New Brunswick from here in Melrose, Mass. Elevation only 100 feet. Granted, he was using an 11 over 11 beam.

So the 432'er tends to be low cost if you build it yourself. You may only have to buy a few $1 or $2 tubes plus a few $4 2C39's, if you have a good UHF junk box. Reminds me of the two Hoboes: "If we had some eggs, we could have some ham and eggs, if we had some ham." I will try and add up a possible total. Later.

Receiver. This is working FB. *Not* a superregenerative. It's a super-het with a few $1 tubes and at least 2 frequency conversions.

Beam. A 14 element job, to start with. Nearly 20 db gain. Works great also.

Transmitter. Stop right here. This is the end of the road. Like when you are going mountain topping on a warm summer's day, 24 element Yagi folded on the car roof, Geodetic map of Newfield, Me., in your hand, and that "road" winds up in a barnyard. A real barnyard, with ducks, Geese, couple of cats, more kids, and what looks like the remains of the road wandering on up through an alder swamp. If you ask about the "road" you'll get blank stares. Putting on your more better pair of specs you note two additional items on the map. (1.) The road has become a dotted line at this point. (2) The date of the map says "Edition 1912." That's the way you feel when you try to make an *"economical," "easy to build"* transmitter for 432.

Don't look in the Handbooks unless you want to spend $20 per tube, or own a machine shop, or both. You meet sentences like these: "Any two meter rig with 10 to 20 watts output can be used for an exciter," or , "two 5894's are used, one as a tripler and one as an amplifier." $40 right there. And not any too rugged at that. What I've been after is a rig not too much bigger than a Gonset. Hopefully less dollars if store bought. One you can use mobile or mountain topping. One that you can build without that machine shop. The receiver is OK, as stated, see 73 Mag. The transmitter is based on the use of (A) 2C39 type tubes; (B) low cost series tuned trough-line cavities that you can build with tin snips and a medium size soldering iron; (C) store bought tuning capaci-

tors; and (D) doubling instead of tripling. The results: (?) 12 to 15 watts crystal controlled output on 432. Stable as rock and capabilities of upwards of 25 watts *output* with blower and more dc power. (And more modulator, too.) The tube is rated at 100 watts and is running now only around 35 watts with 400 volts.

We'll sneak up easy like on more power later. When I open up a mine of 2C39's.

Transmitter Tubes

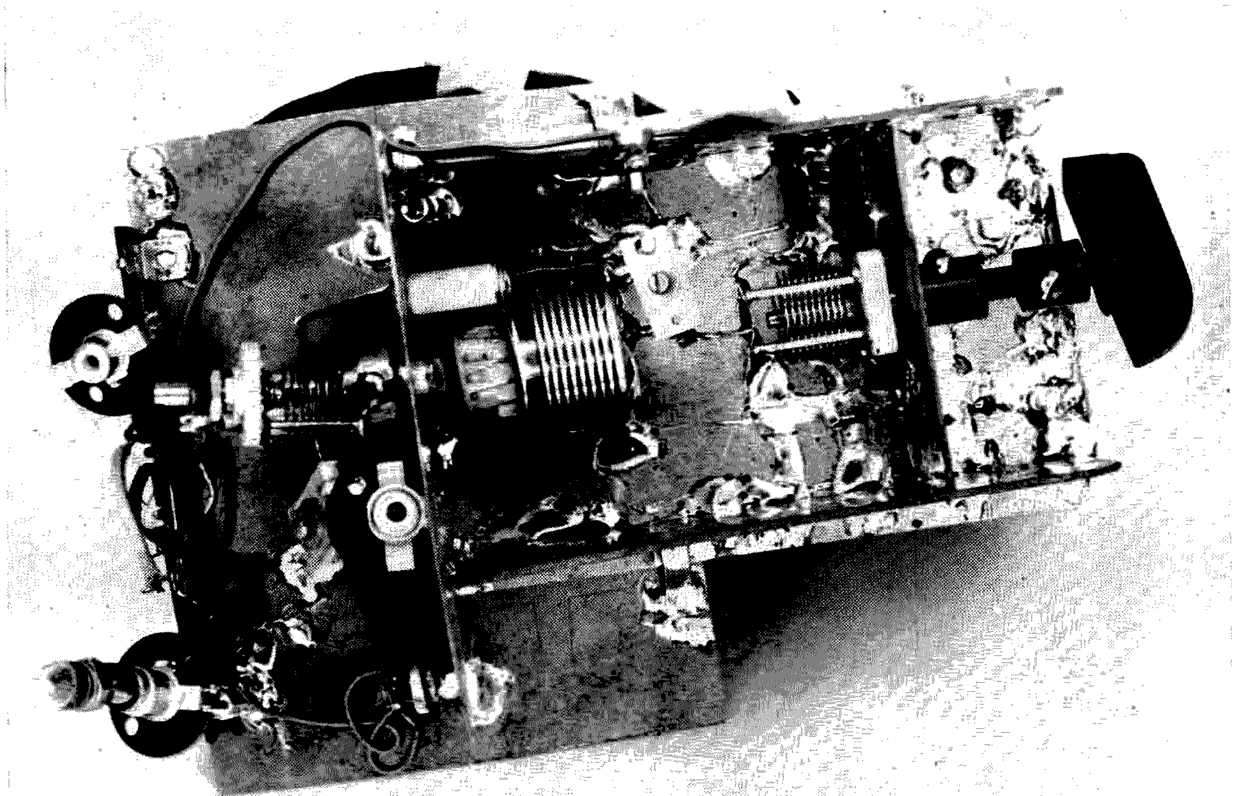
The question of what tubes to use is of course at the heart of the whole 432 deal. Not that there are large numbers to chose from. There aren't. Let's look over the few that are available. I originally considered and tried out the 6AN4. A nice clean little watt. Nothing to write home about, and no margin for increase in power. I also burned out several.

Next. The 6360. A nice delicate little bottle but not too good on 432. Lacking in reserve power for use as a doubler. Besides, it has a newer brother, the 6939, which is capable of 5 watts on 432. However, here again no power reserve at all. No possibility of graduating up to the next class of power. Not only that, but I have had several talks with different high band (UHF) mobile people who have tried this jumpy little compact on UHF and they had to give it up. Too touchy for production use. You can get one running, sure. But don't forget, this 432'er is being built and designed so that any number of junior type operators can build up on the first UHF band with a good assurance of success.

Next are the newer double pentodes, 6524, 5894, etc., the modern versions of the 815, 832, and 829. In the handbooks are a few words concerning these tubes such as: "A two meter rig such as a Gonset or similar is generally available for use as a driver." That does not suit for a rig in one box with a handle on it. These double pentodes do work and do put out on 432. So? The price: $20 or so *each*. They also must be used in push-pull, and this brings up something else. You can't double with them. Don't forget the fact that the rf is *not* referred back to the cathode. It "floats" back and forth from grid to grid, and from plate to plate. That's OK for push-pull, but not for single ended work. Also, you can't go on up to 1296 at all.

The field is getting narrower and narrower, as you can easily see. There are some beautiful ceramic planar (fancy name for disc-seal lighthouse tubes) tubes but believe me, don't even start to look up the price. If you have to *ask* the price of such tubes, you're in the wrong store!

All this leads up to the good old 2C39 type tubes. There are several versions, such as 2C39A's and B's, and even some four-number



Doubler 216-432 grounded cathode

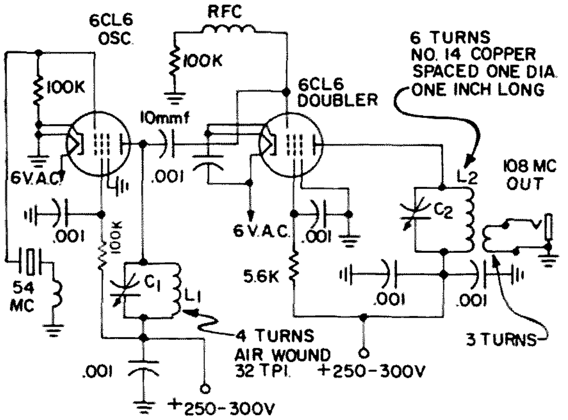


Fig. 1—Crystal oscillator and doubler
Note: ground doubler cathode.

jobs, and the rugged types with WA after the numbers, and also some with real fancy handles like 3CX100A5, 3X100A11, and so on. This is natural because of the success of the original 100 watts at 2500 megacycles. Some say "full ratings at 500 mc" and some say "full ratings at 2500 mc." For 432 they're all good. And best of all, there are plenty of them surplus—both in and out of surplus sets—sometimes with cathode, grid, and plate connectors, if you're lucky. Prices I have paid have been $4 and up. In most surplus Goodie lists they are around $7. Not too bad. And that isn't all, by any means. You can operate them as grounded cathode doublers and take full advantage of their fantastic transconductance of 24,000! They have no leads on them, not even short ones. Just surfaces of good conducting metal. In grounded cathode work, power can be maintained and even increased instead of dropping down while frequency multiplying up into UHF. In some handbooks you find, "The tripler has a gain of one half." You won't get far with *that* kind of operation. As you will see in the complete rf section, we go up in rf output power as we multiply. You will notice the following in large commercial rigs, like UHF Tee Vee: They reach around 300 mc, then pause for awhile and insert a straight-through amplifier to bring the power back up again, and then go on up. While on tubes, I should mention that plenty of cathode surface emission of electrons is one of the reasons for the success of the 2C39 family. Keep in mind that Gm of 24,000.

Trough-Line, Series-Tuned, 1/4 Wave Cavities

By now I have built enough of these small signal rf amplifiers, mixers, and rf power amplifiers with different tubes, to find out that they do a fine job up to around 500 to 600 megacycles, or 432 and to spare. Using easily cut and soldered copper-clad bakelite, with perhaps one wall of thin brass where connections are made on *Both* sides and a 50 mmfd tuning capacitor, you get 20 db gain on reception, good filter action, and plenty of watts out on transmission. Reasonable size, too. 2 inches high, 3 inches wide, 4 inches deep. That's about it. This transmitter rf section appears to be a "break-through" for the amateur UHF art. Comments appreciated.

Circuit

Crystal-oscillator doubler. A 54 megacycle crystal and a 6CL6 starts the ball rolling. See Fig. 1. You can use a 27 megacycle crystal if you want to. But that takes another tube or complicates the circuit, and there's a chance for harmonics every 27 mc instead of only every 54 mc. Actually, with the link coupling used, this may not bother you at all. (Of course, it isn't *you* that would be bothered anyway!) The 6CL6 is a well known tube designed for video use, so it is a high gain medium-power pentode. Used in your present writer's phase-reversing crystal-oscillator circuit it puts out FB on 54 mc and will not put out on any other frequency. For those readers meeting this circuit for the first time, (After all, 73 Mag. *does* get new readers every month!) a crystal control functions by just that phase reversal. A mechanical pressure causes positive charges to appear on one side and negative on the other. Also, dc across the crystal causes it to shrink or expand mechanically. Ac on it will alternate such mechanical action. When the physical compression—expansion waves (which operate near the speed of sound in the crystal) bounce back and forth at sound wave resonance, the crystal has a very high Q at the corresponding electrical frequency of excitation (determined by the thickness of the crys-

Doubler 108-216 grounded cathode 2C39.

tal) and thus acts like an inductance, but *better*.

It will be noted that there is still, at any given instant, positive charges on one side and negative on the other. This phase reversal causes the oscillator circuit to be regenerative on the crystal frequency but degenerative at all others. This makes it quite fool proof, increases the power output, and starts it off with greater reliability. The next 6CL6 doubles to 108 megacycles, with the circuit designed for maximum power output. There are some new tubes around which may do better; one of these being the 6HB6 which has a transconductance of over 20,000 and a possible dissipation of ten watts. However, not having tried it yet I am not recommending it yet. The most positive and absolute lesson I have learned in some 43 years of electronic work (*Yes*, Junior, they used to call it Radio in those days!) is to not say anything about any part of electronic ideas that I have not yet tried. Once upon a time long long ago in Paris, France, I designed a type 24 tube oscillator-mixer which I did not realize was marginal in operation. In production nearly 100% of them squealed all over the BC band. Don't say I didn't warn you.

There is also a strong possibility that the good old 5763 (a "high-power video" tube famed for power frequency multiplying that is to be found in the transmitting tube section of the books rather than in the receiving sections) would put out more 108 mc rf. Here again, the 6CL6 is working FB now. Also, while I am not a fanatic on conserving power, there is no need to use up more dc than you have to. You will find that crystal control of a UHF transmitter will use *plenty* of power just in the multiplying stages.

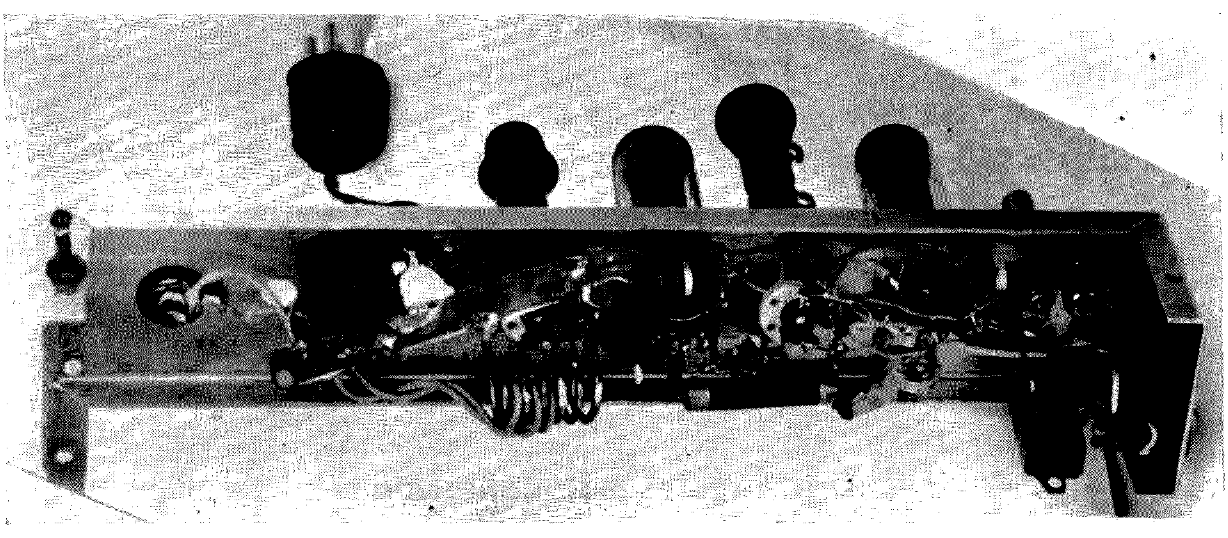
Link coupling is used on the 108 megacycle output. The rf at this point should register on a 6 watt 115 volt bulb. I just tried it again to see for sure. It lights about 1/4 to 1/3 brilliant.

108 to 216 Doubler

Good design data begins to thin out remarkably right about here. Lots of fine tubes are left in the lurch somewhere near 2 meters. Tubes which have terrific plate dip, even at triplers around 100 megacycles, and still put out something around 144, give up the ghost before reaching 216 mc. Like the 2E26, 6146, etc. The 5763 does not handle well on 216 either. Not wanting to go to the little but complex 6360 or 6939 midgets whose output is strictly limited, I installed my first 2C39 at this point, as a grounded cathode doubler. I have not regretted it since. Just a mention again that it will take 50 watts and laugh. You can just tie the B plus lead along with the 216 doubler stage and the final B plus, at the unmodulated point of course, and run it anywhere from 400 to 600 volts. Over 600 volts better use a blower.

The design philosophy calls for a compact complete station around 30 to 40 watts, without blower. For home, mobile, or mountaintopping, and field day work. With capabilities of 100 watts with blower, increased modulator power, and power supply. This last version, a "432'er Senior," would of course weigh out a little more on the scales. Perhaps not too good on a walk-up type mountain but still OK on the drive-up ones. Will be the subject of later articles.

Take a look at Fig. 2. You might say it looks easy? Simple like. Even old-fashioned? Well, that tube is from WW2. Some 20 years old, at least. They've made new ones but they all look remarkably like the old standard 2C39. The thing to remember here is that there are no leads or pins on these tubes. When you make a connection here you do it with at least



Exciter 54 mc crystal—108 mc output

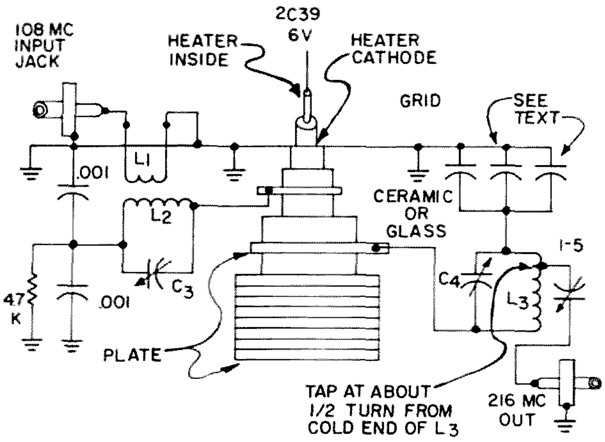


Fig. 2—Power doubler, 108 to 216 mc. L1 = 3 turns interleaved in cold end of L2. L2 = 4 turns no. 16 copper 5/8 long, 1/2 inch diameter. L3 = 3 turns copper strap, 1/4 inch wide, 1 1/2 inches long winding, 9/16 inch diameter O.D. Note: L2 connects to grid ring.

¼ inch copper strap, or finger rings. Anyway, it doubles FB from 108 to 216. More out than in. A power gain of around 2 times, with still only 100 volts on the plate. The 6 watt bulb is over ½ brilliance now.

So much for power. The circuit is beginning to be dependent on the construction at 216 megacycles. Using a copper-clad bakelite baseboard, the cathode is well grounded on a small upright bracket. I have been using mainly surplus 2C39 connectors so far, but have not located a mine of them as yet. Anybody help here? I also use ready-made heater-plugs, and cathode, grid, and plate finger rings from Instrument Specialties Co. in Little Falls, N. J. Actually the grid plate and cathode connections can be made with ¼ inch wide thin brass strap and 2/56 hardware. That heater plug is still a nuisance! It does have a part number at Instrument Specialties, tho.

Mount a resistor support for L2 so you can solder one tab directly to the grid connector. Do not use leads anywhere from here on up. Use as many bypasses as you please on the coil returns. I always have a collection of large and small disc capacitors taped onto the end of some "coffee sticks," with the leads cut to about 3/16 of an inch. Every now and then I go over the circuit, touching these test capacitors across the one (or ones) in circuit, and also in places where there may not be any yet such as filament leads, B plus terminals, etc. Whenever a difference in operation is noted on the meters or rf output I add another. The plate inductance L3 return actually has five of them on it right now. One small button, one large button, one .9 mfd disc, one bakelite encased mica, and one pressed glass mica. It's not really so much a

matter of mmfd as it is a matter of lead length. And the fact that paralleling leads cut down the inductance of even a piece of wire only ⅛ inch long. That isn't all. On 432 it gets worse! The schematics may show some leads, but don't use *any!*

Incidentally, though I don't like to mention it, I use "phono" jacks and plugs throughout, even on 432. And even on 1296! There I'll admit I'm dead wrong. I mean, I *know* it's wrong, even though it works. More later on the subject of connectors. Some of those ceramic phono jacks and plugs can be made to work. Now let's see how to get to 432 without half trying. That is, without *you* trying. I've already done it the hard way.

Doubler, 216 to 432 mc

Things are getting tougher. Granted. It still isn't *too* hard tho. Just follow directions herein and study the "schematic," Fig. 3.

The cathode should be mounted first on the mounting bracket, which is a ⅞ inch wide brass strap mounted vertically on the baseboard. A large hole for the grid-plate insulator (glass or ceramic cylinder forming the center part of the 2C39 tubes) is cut in the front wall of the trough-line box. Leave plenty of clearance for the ceramic or glass insulator between the grid and plate. Not critical. As with a doubler there is no feedback that counts. See Fig. 3B.

LI should be mounted so the hot, or tuned end is close to or touching the grid ring or strap connector. C2 has a screwdriver slot in it. Use an all-insulator screwdriver. J1 is mounted on the front wall near the middle of LI. No leads are used.

Getting into the plate box now. I used two pieces of ¾ inch vertical copper strap from the plate ring, or connector strap, to go around each side of the plate heat radiator. This leaves room to blow air through the radiator later if you decide to go up towards 100 watts. These straps are joined together and soldered to L2 which then goes only a short distance to C3. Actually of course, the plate inductance begins with the plate itself way up in the front wall hole. Then, out along the plate connection, around the heat radiator on the straps, onto L2, and continues on *through* C3 whose stator plate rods form the cold end of L2. It is not completely cold, due to the series tuning used with the 50 mmfd of C3. This is seen to make L2 nearly 4 inches long total. The B plus lead is attached to the coldest end which is the low impedance end of C3, then through a choke coil where there is not much rf *voltage*. There is plenty of current

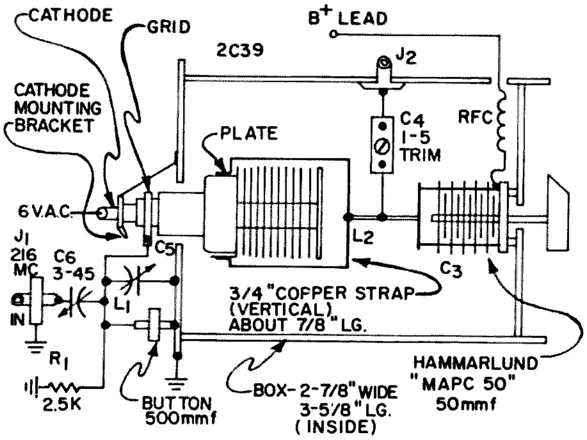


Fig. 3A—Doubler 216 to 432 (top view). L1 = Copper strap, ½" wide, 2½" long, spaced ½" from front wall
Correction: Strap is not L2, but connects L2 to C3. Cond. is MAPC-50B.

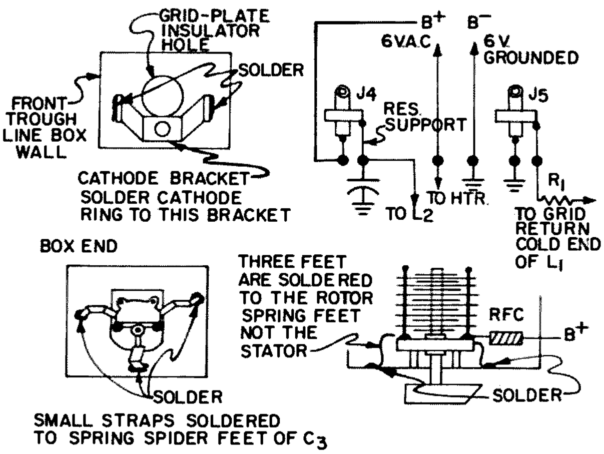
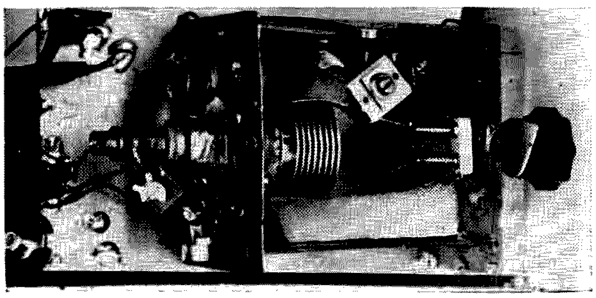


Fig. 3B—Front view, box front wall
Fig. 3C—Economical metering and "fusing." Note: Plug meters into J4 and J5 for current readings. Plug pilot bulbs into them for fusing and current indication.

though, but this is flowing through C3, over the grounding straps (see Figs. 3D and 3E), and onto the end of the trough-line box. From there the rf starts back to the plate-cathode region again via the box walls. Note in passing that this rf has nothing to do with the flow of electrons. This rf is the famous "Maxwell's displacement current," and goes at nearly the speed of light along the copper. The electrons flow from the cathode to the plate on positive grid pulses at less than one tenth the speed of light, and eventually establish an average equilibrium through the plate meter, power supply, B minus lead, ground, and back to the cathode.

C4 is a mica trimmer connected to J2, which is a phono jack soldered in three places to the side wall of the box. Note that these units (the various stages) are all link coupled with cables, and still manage an increase in power



432 ground grid rf amplifier

while multiplying up. (Through phono jacks and plugs too!)

Fig. 3C shows an economical way to monitor and fuse the grid and plate currents. Various bulbs can be plugged into the jacks. The heavy amp ones act as fuses. MA ones such as the no. 49 2 volt 60 ma, make a good indicator for currents under that figure (60 ma). Opening the plate jack and monitoring the grid current with a suitable meter, such as 0 to 50 ma, allows the grid circuit to be tuned up. A 6 watt 115 volt bulb plugged into the plate jack makes a nice tune-up resistor. Figs. 3D and 3E show some details of the plate choke connection and the C3 rotor spider grounding straps. I'll check the rf output on 432 once again just to make sure. It's close to 5 watts now. Just a slight difference in the brilliance between the 432 rf output and the same bulb plugged onto the 115 volt line.

Note that these are grounded-cathode doubler stages. They do *not* have the drop in gain associated with grounded grid stages. The tubes were designed for grounded grid. That is, the physical design allows their use in coaxial cavities. But that needn't stop you from taking advantage of the high Gm and the absence of electrode leads. I assure you, new tube design is not complete yet!

Rf Amplifier, 432 mc

I tried grounded cathode here also. NG so far. I'm still going to try some more, "when I get time." Too much interreaction between plate and grid. Mind you, this makes no-nevermind at all when doubling. Grid on 216, plate on 432, no trouble. But just put the grid on 432 and tune the plate thru 432 and whammo —grid current disappears, and results are N.G. I've got ideas on UHF neutralizing. But for the moment, let's get on the air!

Fig. 4 shows the circuit. And it does work. Like FB! If my plate supply would get up over 400 volts I'm sure I could burn out that 6 watt bulb! With the 400 volts, it appears to be somewhere between 12 and 15 watts of crystal controlled rf out. At least. Because those light bulbs are none too good as wattmeters, but any drop is on the beneficial side. That is, there may be *more* than 6 watts but there *can't* be less! And not a trace of feedback so far.

Note that in this final, the grid is grounded directly—both for rf and for dc. This raises problems in getting bias voltage. You can use a grid bypass ring or plate but this is not actually too easy. It also is very often a continuous and annoying source of feedback with oscillation, unless the capacity is high and *particularly* the inductance has to be low. At any rate, it isn't easy to do. The quickest and easiest way to do it is with a separate filament transformer for the final. See Fig. 4A. Grounded grid cavities have always had this problem. If you lift the cavity, with its dc grid connection off the ground, then you have to worry about your input and output cables shorting the grid bias voltage.

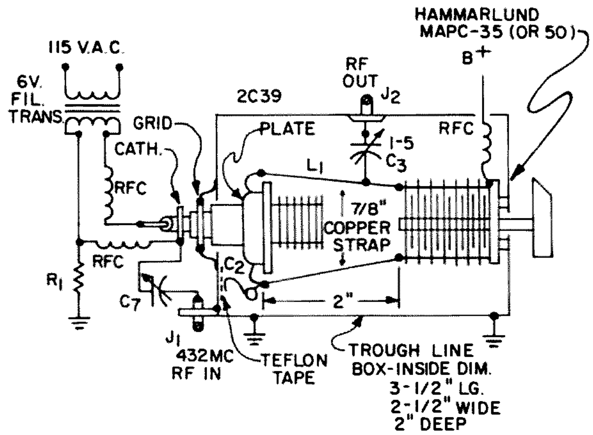


Fig. 4A—2C39 grounded-grid rf final, 432 mc

Unfortunately, the 2C39 has the cathode permanently attached to the heater lead. So unless you lift the entire 6 volt system off ground, you can't use it for bias. If you do that, then your doublers have to be reworked. So just use a filament transformer for now. RI is the simple bias resistor as a result.

So far I have coupled the input directly to the cathode through CI and pruned the cable length a little without other tuning of the

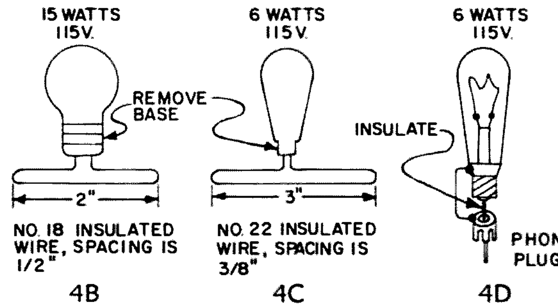


Fig. 4D—Note: 4B and 4C are inserted inside the cavity alongside L1. 4B, 4C, and 4D lamp bulb loads are shown for 432 mc

cathode circuit, and have had plenty of drive. We'll check that again on high power. (After installing a blower.)

As for the plate circuit, I was pleased to see that with box and strap dimensions given, the frequency was a shade too high. Rather than rebuild the box I added C2, which is a copper tab about ¾ inch long soldered onto the plate ring and spaced about 1/16th inch from the inside of the inside of the front wall of the box. Adjusting this C2, you can set 432 to be near the maximum on C3, which is the highest Q position.

Rf test lamps that work, after a fashion, on 432 are shown in Figs. 4B and 4C. 4D shows one that can be plugged into the output jack. Some lower impedance lamps are better when used with those cable jacks. A variety of ranges in watts can be found in the "radio" stores.

Incidentally, 2C39's are available from Arrow Sales in Chicago at $4.95.

This about winds up the rf section. See you on 432. I'm on now.

. . . K1CLL

Improving the Heathkit Q-Multiplier

The Heath Q-Multiplier, particularly the current model HD-11 with internal power supply, is a very useful piece of gear overlooked by many amateurs as something to be used by the novice ham with his inexpensive receiver. Actually it is a very easily installed item, which will plug into an already prepared phono socket in 75S-1 and KWM-2 Collins gear, with no modifications. It should be used only in the null position, as this gear has all the selectivity it needs and will prove a revelation to ex-75A4 users who were used to that otherwise superb receiver's Q multiplier knocking the desired signal way down, along with the interfering heterodyne. The Heath can be tuned across the receivers *if* passband like a knife blade and causes no drop what soever in signal strength while nulling out whistles.

The circuit uses a 100 mmfd variable capacitor for tuning which is about ten times as large as is necessary making it a little hard to "hit bottom" with the null, in spite of the vernier built into the condenser. By simply removing four of the six rotor plates (wiggle them out with a long nose pliers) and re-dipping coil L2 so that the dial pointer is about midscale you will really improve an otherwise excellent and useful accessory.

. . . W9THN

The 432'er

Modulator

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Except for one item, you can use your favorite modulator, if you have one. For my money I like a pair of 6L6GC's. 50 watts of audio. Actually rated for 55. That should take care of the 2C39's in the 432'er, even with blower, and running a cool (?) 100 watts. (We'll see how cool this can get to be). Except for one thing. You are supposed to modulate the driver of a grounded grid stage about 70%. I don't take this for granted. Also I learned on the air last night of a lad who modulates the driver of his grounded grid stage *without* modulating the final. That is, other than the drive being modulated. Makes it some kind of linear amplifier. (I hope, for his sake).

At the start of a new project read everything you can about it, do all the paper work you can, and then go to the bench and start building.

We were starting to talk about modulators. Again, you can use whatever you have to get going but how are you going to take care of that 70% business? Of course, my specialty is UHF, so this modulator is almost sure to be bettered. Let me know about it, please. But if you want to go right ahead and get on the air on 432, and I hope you do, because I've never heard of QRM yet there, just make up this one. It works, like the rf section. After all the "in the shack tests" with generator, power detectors, scope, etc., I like to take a rig over to a friend's house and then see if the audio can be understood a ½ mile away. Then I check to see if his voice is recognizable as his.

In general, one should use what can be considered "good practice." Of course, this won't bring you anything *new*. So you have to stick your neck out a little.

Again, this modulator works. See Fig. 1. There *is* a requirement. The driver modulation must be in phase with the final modulation. Don't get snowed under by "phase." It just means an event that occurs in both places at the same time. Even though Einstein says it can't *really* happen.

So, just be sure and modulate the driver. That is, the 216 to 432 mc doubler stage which is grounded cathode. Thank goodness, or we might have to modulate *that* driver too! The easiest way, however, is simply to modulate the driver along with the same modulated HV as you use on the final, and adjust the grid bias of the doubler for the best match. How does this sound on the air? First reports "Modulation very adequate." Also, there is now upward modulation.

Circuit

Again, handbook trouble. There are some nice little circuits in "the Books" using one of the many double triodes; one half as first stage, the other half as second stage. Immediately on building it I got af feedback. I don't like that. Not right away like that. Back to RCA basic books. I've mentioned this before several times. RCA, to push up sales and help keep them sold (a perfectly laudable ambition), publishes a lot of real handy-handy information. Read IT! What a tube is. Why it does what it does. How to connect it up. How to get it going right and keep it going.

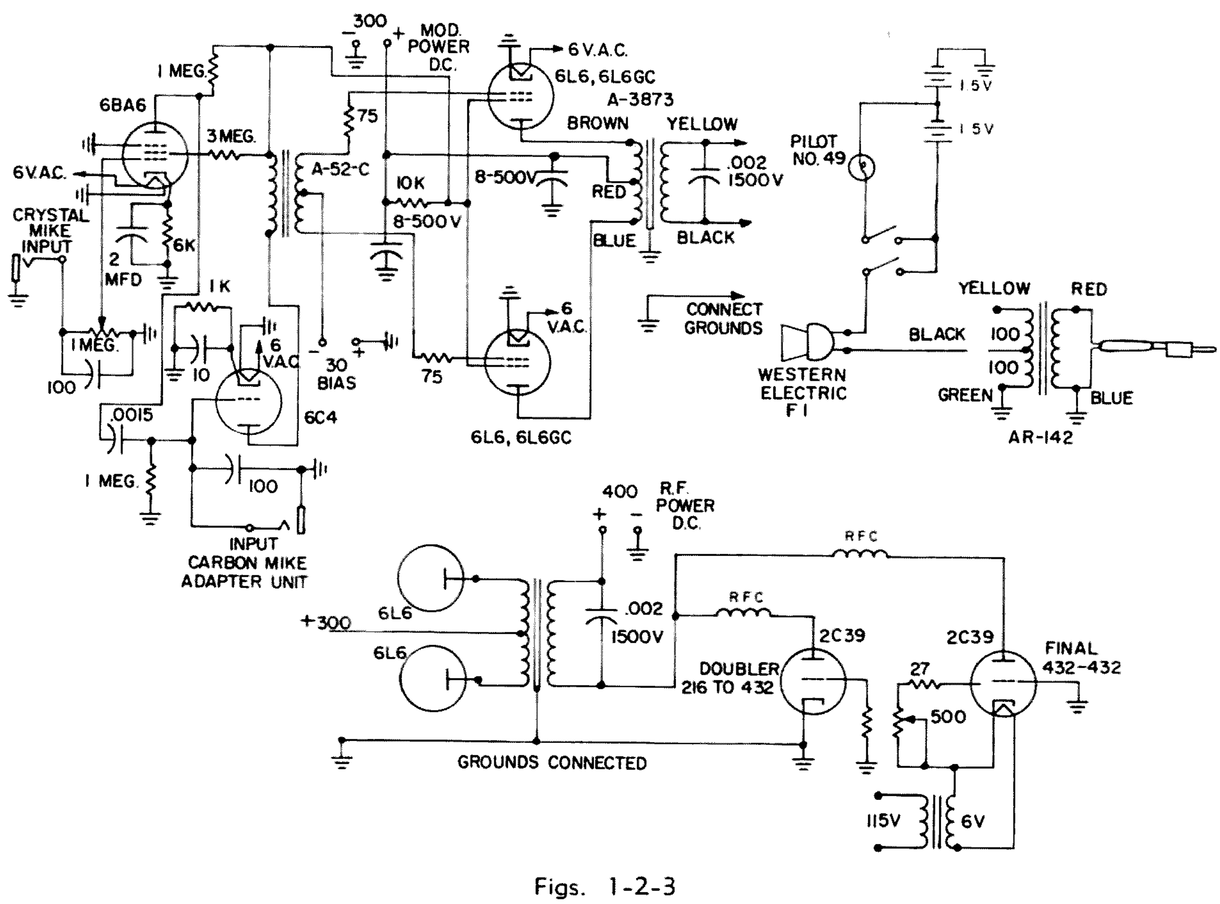
You want a first stage modulator? Dozens of tube choices all detailed out, grid resistor, cathode resistor, bypass, screen resistor and bypass, plate resistor and coupling capacitor to next stage, next stage grid resistor, voltage gain to be expected, gains from 12 to 400 detailed, etc., etc. For $1.50 how can you go wrong? All related of course to RCA tubes but why not? They're good. Same price, too.

So the first stage of the modulator uses a pentode fitted up with high gain components. Plenty of gain using a crystal mic. And what was the first result on the air? rf feedback! But bad! Gain control at zero, steamwhistle. I would suppose nearly 100% of all amateurs, including you the reader and certainly myself, have met up with this devil. As a matter of fact one of the stations I contacted on 432 last night on my historical (for me) first evening on 432, had it too! After a little playing around with grounds, practically useless at 432, bypasses (didn't work this time), shields, moving the mic cord around (an old trick) (didn't work either), I decided to "Cut the Gordian Knot." Some will say that's not sporting but it sure works! So I took the 6BA6 (was supposed to have been a 6AU6 but didn't have one on hand out and connected a very high gain carbon mic transformer to the grid of the driver stage. Results? No rf feedback since that moment.

Remember that 432 radiates like mad from every little crack and lead and is picked up by every little lead also. In the speech amp, it may be a long process to adequately shield a portable speech amp for 432, especially when the complete station is going to be a compact—suitable for mobile, home, or mountaintopping. Incidently, there is *one* carbon mike that actually sounds like crystal on the air. But only one. This is the famous Western Electric Fl "Button." The ones you could buy in a telephone booth in the old days!

Fig. 2 shows the carbon mike plug-in unit. A good try will be made to get the crystal mike back in use again when assembling the compact station, but no guarantees on that. Maybe one of the little transistor amps will do the trick, if put in a *really* sealed-in box.

Let's take a look in the RCA books again about the modulator tubes and the prices. You can go through all the pages and I don't think you can beat the 6L6GC. The Eico modulator on my 100 watt two meter rig uses those nice English type tubes, but they cost more. The 6L6GC runs up to $2. Under pushpull Class AB1 amplifier service we find "Maximum signal output 55 watts." That's



Figs. 1-2-3

audio power. Modulator power. Plenty good enough for any 100 watts of rf for my $2.

As a shortcut to getting on the air I used about 30 volts of battery bias on the 6L6 grids. Someday, "If I ever get time," I'll build a little bias supply into one of the power units. This could help for protective bias, keying, etc. Oh well, in the meantime I'm on 432.

Another little item. I have a nice 60 watt modulation transformer. Multi-match and all. Had it here since 1954. So naturally it went into action. I'm used to hearing modulation transformers sing as they go into action, but this one sounded extra rattly like. Sure enough, it was arcing over inside, and I couldn't stop it. It kept it up right up until 6 PM Wednesday evening, with the gang due on at 8 PM. In desperation, as I moved out along the attic 3rd floor shack here (my junk box is 45 feet long) looking for my old KW modulation transformer, my eye lit on a nice little stocky shaped black unit. Oh Boy! "Modulation Transformer, A-3873, Audio Power 25 watts." In it went, outboard . . . B plus clip leads on the secondary over to the rf final and driver-doubler. Saved the day. Or rather the evening.

. . . K1CLL

The Heath Kit HP-23 Powers the Swan 100 Series

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In the Swan Instruction Manual is a modification of the Heathkit HP-20 ac Power Supply. Since this is no longer available, having been replaced by the HP-23 ac Power Supply, it was felt that a modification of the HP-23 would be of interest to those that need a ac supply.

The HP-23 is a full-wave voltage-doubler for the high voltage, a half-wave voltage-doubler for the low voltage, and a half-wave rectifier as the bias supply. All rectifier diodes are silicon. High voltage is 700 volts under load instead of 600 as in the HP-20 and will drive the Swan to 175 watts PEP input. Dynamic regulation is improved over the older model, as well as a switch has been added wired in series with two terminals of the power output socket so that the supply may be located some feet away from the transceiver, at the end of a 8-conductor cable.

A 11 pin socket is used to bring out all voltages and control circuits. Four changes are necessary to use with the 100 series transceivers. First connect as per Heath Assembly Manual for a low voltage of 300 volts. The second change is to jumper pin 2 to 7 of the power socket, this grounds one side of the 12vac filament winding. 12vdc is needed for the Swan T-R relay so the third change is to add a silicon diode between pin 6 and unused pin 5, cathode to pin 5, most any PIV and ma rating should do. Also needed is a 100 mfd-50v electrolytic connected positive to pin 5, ground the other end.

A bias voltage of − 100 volts dc with a 20 ma load is available at pin 1, labeled Fixed Bias. Also available is a adjustable bias voltage with a range of −40 to −80 volts dc, this would be fine except it is only rated at 1 ma, and 6 ma is needed. So back to the fixed bias supply for the fourth change. Add a 4.7 K/1 watt resistor in series with the yellow lead from lug 2 of terminal strip D. I used a 1 lug tie-point near the power socket to anchor one end. This change is required to lower the bias voltage (should be in the range of − 70 to − 100 volts dc) and to adjust for a Swan PA Bias of 25 ma.

A 8-conductor cable is furnished with the HP-23, connect as per chart, adjust PA Bias, Tune & Load, and be on the air Saturday evening after a good afternoons work.

. . . K6LOP

Function	Power Socket HP-23	Color	Power Socket Swan
Fixed Bias	1	yellow	3
300 vdc low voltage	3	orange	10
700 vdc high voltage	4	red	8
12 vdc relay	5	blue	5
12 vac filament	6	black	4
ground	7	brown	6
power switch	9	white	1
" "	10	green	2
External speaker			12
" " ground			6

Sinusoidally-modulated Calibration Oscillator

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The problem of rapidly and surely identifying signals from the receiver's calibration oscillator has been with us for several decades, and has become particularly troublesome recently in some of our "electronically saturated" regions, such as Greater Boston and the San Francisco area, where literally dozens of unmodulated carriers of various frequencies may be on the air at any given time.

This problem was noted some years ago by Langford-Smith [1] who suggested that pulsing the calibration oscillator by means of a neon oscillator might be a workable solution. A number of neon oscillator modulated calibration oscillators have been perpetrated by the present writer [2], with results that were helpful, but not entirely satisfactory. The chief problems included difficulty of controlling the percentage of modulation, so that overmodulation, with resultant splatter, was most difficult to avoid; and "spread" of the calibration signal, due to the almost infinite number of audio harmonics resulting from the sawtooth output of the neon oscillator. These difficulties were not insurmountable, but made the neon-pulsed calibration oscillator a most tricky device to put into, and maintain in, satisfactory operation.

Requirements

For thoroughly satisfactory operation, a modulated calibration oscillator must have the following attributes:—

1. A stable high frequency oscillator, rich in harmonics.
2. A sinusoidal audio oscillator, poor in harmonics.
3. Adjustable modulation percentage.
4. A satisfactory and "clean" mixer.

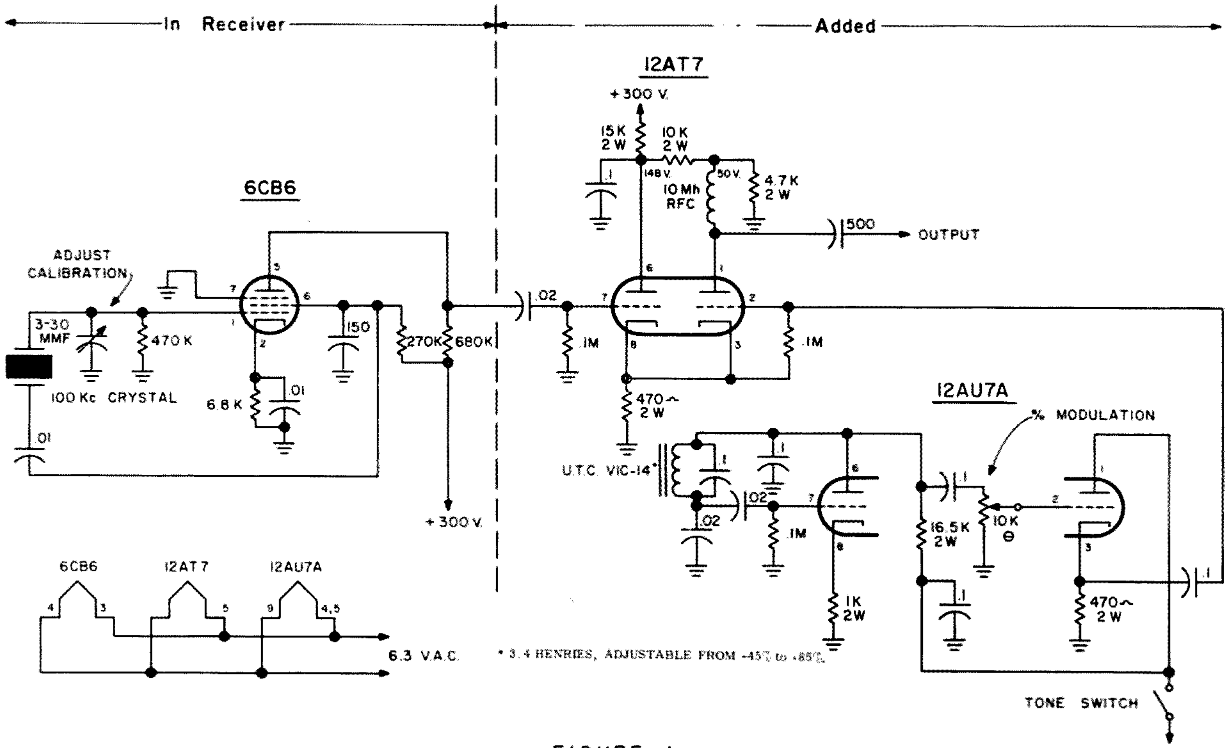
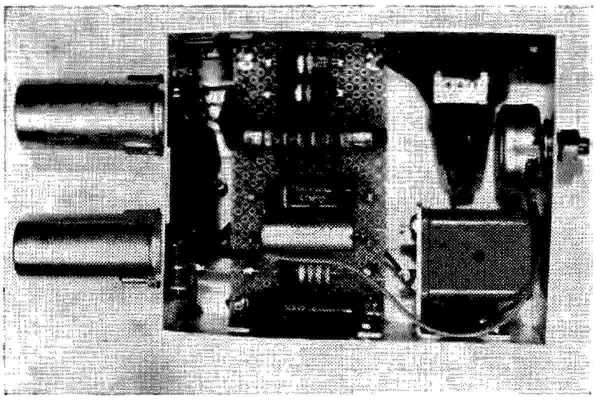
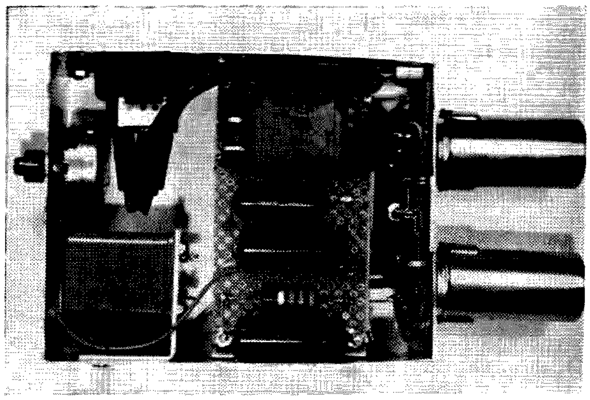


FIGURE 1



Top view of oscillator identifier with covers removed.



Bottom view of oscillator identifier with covers removed.

Happily, there are a number of very stable and satisfactory high frequency oscillators, among which the electron-coupled crystal oscillators are the most popular.

The sinusoidal audio oscillator, poor in harmonics, can be a conventional Colpitts circuit, using a single high-Q untapped inductance, with both high-C and degeneration to reduce the harmonic output.

Adjustable modulation percentage is easily provided by use of a conventional potentiometer between the audio oscillator and the mixer.

The mixer problem is adequately solved by use of the Pullen[3] dual-triode cathode-coupled mixer, which is remarkably free of unwanted mixer products (harmonics and the complicated beats produced by them), provided no part of the circuit is overdriven.

Working Circuit

With the foregoing fundamental requirements decided, the working circuit of Fig. 1 was developed, and, after rigorous checking, built as a permanent receiver adjunct. It should be specifically noted here that several alternative circuits, some using less tubes, are entirely workable; but once the "one function per tube" concept is abandoned, the apparent saving in components is likely to be offset by functional interaction, difficulty of adjustments, and other gremlins, some of which are most difficult to exorcize.

How It Works

The 6CB6 100 kc crystal oscillator produces clean signals at 100 kc and all integral multiples thereof up to roughly 50 mc, with some falling off of amplitude above about 30 mc. Because of the electron coupled circuit, frequency is substantially independent of load. As is conventional a trimmer capacitor is provided to permit zero beating of the crystal oscillator with some more accurate standard such as WWV.

The oscillator output is fed to the right half of the 12AT7 mixer, which is a cathode follower. The same signal, not voltage amplified, appears across the cathode resistor of the mixer, tube, and drives the left triode of the mixer. If no signal is applied to the left grid of the mixer, which has a low impedance to ground, the 100 kc signal, amplified, appears at the plate of the left triode of the mixer, which is the circuit output. Use of an rf choke in this plate circuit permits greater amplification at high frequencies than at low, a usually desirable condition.

When the audio oscillator (left 12AU7A) is energized, that circuit puts out a relatively strong sinusoidal signal, at a low frequency, determined by circuit constants and adjustment of the core screw of the VIC-14 inductance. Because of the high C of this circuit, and of the extreme degeneration introduced by the 1000-ohm cathode resistor, wave form is cleanly sinusoidal, and harmonics are at a minimum.

A selected portion of this signal is fed to the right half of the 12AU7A, which is a cathode follower, and from the cathode of this triode to the left grid of the mixer. Here, the audio signal varies the amplification of the mixer output tube, effectively modulating the high frequency already in the circuit. By adjustment of the "% Modulation" control, amount of modulation can be varied from 0 to somewhere around 200 percent.

The entire power supply is controlled by a switch already in the receiver. An added switch ("Tone SW.") is provided on the panel,

[1] Langford-Smith, F. "Radiotron Designer's Handbook," Fourth Edition, 1952, Harrison, N. J. (**RCA**), 1261.

[2] Ives, R. L. "Dual Frequency Crystal Calibrator," **Radio-Electronics**, Vol. 26, No. 10, Oct., 1955, 34-36: "Identify Your Calibration Signals," **Radio-Electronics**, Vol. 31, No. 9, Sept. 1960, 56: "Modulated 10 kc Calibration Oscillator," **Electronics World**, Vol. 66, No. 6, Dec. 1961, 55-57.

[3] Pullen, K. A. "Conductance Design of Active Circuits," New York (Rider), 1959, 259-263.

to permit disabling of the audio signal, for zero beating of the xtal oscillator and other checking purposes.

Construction

Because the crystal oscillator was already an integral part of the receiver, necessary construction included only the audio oscillator and the mixer. Using all standard parts, this was easily fitted into a 2" by 5" by 6" utility box (LMB UC-972 cut down), which in turn fitted the space available within the receiver cabinet.

Tubes were mounted to project horizontally rearward. Power and signal connections were made by means of a plug at front right. Some components were wired directly to the socket prongs. The audio coil was mounted on a bracket at front left, with the adjusting screw up, so that the audio frequency could be adjusted easily. Remaining components were mounted on both sides of a glass epoxy board (Vector 85G24WE, with T 28 terminals), which was bracket mounted across the case. By judicious arrangement of the components, the wiring of the circuits is minimized. Alternative layouts, to fit available space or personal preference, are entirely feasible. The bulk of the identifier unit can be reduced by a factor of more than two by use of "miniature" components, at a considerably higher cost in parts and labor.

Adjustment and Use

When construction is complete, and wiring is checked, connect the identifier, and roughly check it to make sure all component circuits work. Then, using an oscilloscope, adjust the "percent modulation" to about 95. Do not, under any circumstances, exceed or crowd 100 percent modulation, as this will immediately cause splatter, which will not only make the calibration oscillator less useful, but may also cause interference over a wide area (several blocks), on several or many bands.

With modulation satisfactory, check coupling to the receiver. As the mixer is also an amplifier, reduction of the coupling is usually desirable, to prevent overloading the receiver input, with resultant cross-modulation and spurious signals. Coupling sufficient to give the calibration signals a strength of about S3 is usually optimum. Logging of the strength of the calibration signals at each end of each band will furnish a good check, at a later date, on receiver performance and its possible deterioration.

To give as sharp a calibration signal as possible, the audio modulation signal should be of as low a frequency as convenient. This can be set by adjusting the core screw in the UTC VIC-14 inductor. With constants shown, modulation frequency is 420 cycles with the screw all the way in.

In use, the calibration oscillator is turned on, with the audio tone operative, and the desired frequency is spotted by noting the audio tone. If a very high precision is desired, or for purposes of zero-beating, the audio tone is shut off, and the oscillator used without modulation. For most ordinary purposes, the oscillator can be used with the modulation on, the center frequency point being detected by watching the S-meter maximum. This is a perfectly workable procedure with a sinusoidally-modulated calibration oscillator, as the two sidebands are of equal width. It is not usually a sound procedure with a neon-modulated calibration oscillator, because the sidebands are usually of unequal width, due to the sawtooth waveform of the modulating signal.

The described calibration oscillator identifier has been in full service as a permanantly-attached adjunct of a GPR-90-R receiver for several months. Performance has been eminently satisfactory. The receiver case has not been opened for repairs or adjustments during that time. Further deponent sayeth not.

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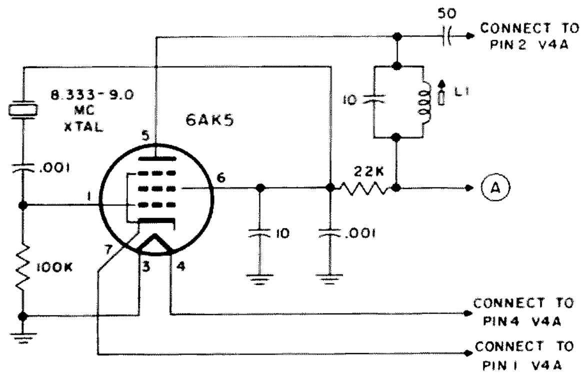
Converting the

Heath Tener

to

SIX

Robert Rose K6GKU
9332 Sage Avenue
Arlington, California



L1 = 24 TURNS # 24
CLOSE SPACED

Many hours of pure pleasure were spent with my Heath HW-19 "Tener," both as a fixed unit and as a mobile rig. However when I moved to a new location, the sagging sunspots and general inactivity of 10 meters eventually caused a thick layer of dust to accumulate on this little transceiver. Therefore when I was stricken with a craving to do some mobiling from the nearby mountain-tops the little "Tener" was rebuilt into a "Sixer" and reactivated.

The largest addition to this conversion is the addition of an oscillator/tripler stage which makes use of 8 mc crystals. The circuit used was lifted from the January 1962 issue of 73 [1] (where else). This circuit has been used in other rigs and has been found to be reliable and rugged. One change has been made in the circuit shown in the original article. The connection at pin 2 of the 6AK5 has been removed. The 6AK5 suppressor grid is tied to the cathode internally. If pin 2 is grounded, the oscillator will remain on while the receiver is on which tends to be annoying.

The unit was built on a small 2″ × 2″ sub-assembly and mounted on the upper right hand backside of the front panel behind the Heathkit emblem. To facilitate changing frequency the crystal socket was installed on the front panel.

The modification of V-4A into a doubler stage involves the rewinding of Coil L201 with 8 turns of number 24 wire.

The tank coil, L202, was also rewound with 8 turns of number 24 wire. One pointer: don't try to rewind the coil without removing the two turn link, and don't forget to replace the link once the coil is rewound.

The last step in the transmitter conversion is to remove the rf Trap, C209 and L203. This little device, if overlooked, will absorb most of the 50 mc signal because in the original 29 mc transceiver, its job was to attenuate the second harmonics.

The modification of the receiver section was a little tricky to nail down initially, but when the bugs were ironed out, it turned out to be a simple process.

To convert the receiver rf amplifier, remove C101, C102, R101, and rewind L101. L101 is rewound with 9 turns of the original coil, with the antenna tapped 2 turns from the cold (ground) end.

The regenerative detector was converted by trimming L102 to 8 turns of the original coil. Some experimentation was made with C111 to try to improve the quench frequency rate. It was found, however, that the original 100 mmfd capacitor produced the best timing characteristics and was left as is.

The last two modifications, although arbitrary, have proven to enhance the operation of the transceiver. The regeneration control was moved to the front panel and placed between the volume control and the microphone plug. An 8:1 per 180° rotation vernier dial was added to the main tuning capacitor, C108. Although fine tuning is not an outstanding feature of the superregenerative receiver, the combination of vernier tuning and careful regeneration adjustment will produce a certain amount of selectivity.

The entire modification took about 4 to 5 hours. A manual is a great help to plow through the maze of components, especially if you didn't build the unit originally. The comments received on the quality of the signal from this station have been very gratifying and the receiver has proven to be disgustingly sensitive. In general the unit has proven to be ideal for the local nightly roundtables and it is felt by the author that this conversion was time well spent.

. . . K6GKU

[1] D. A. Smith, W3UZN—8 mc. Crystal Modification—Page 24.

Varactor Tripler to 432 mc

Tom O'Hara W6ORG
Resdel Engineering Corporation
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Varactor multipliers now provide the typical 2 meter ham using a Gonset Communicator (or converted 522) the opportunity of operating the UHF bands. The problems and expense involved in building tube type multipliers and their associated power supplies are dispensed with. This artical describes a varactor tripler that generates 432 mcs with an efficiency of 70%. 3 actual watts out of a Gonset GC105 Communicator, as measured with a commercial wattmeter, will give 2.1 watts output.

This transmitter-multiplier system has reliably produced 5 x 9 signals over a 70 mile clear path in the Los Angeles area. Similar multiplier schemes are providing dependable results between the Hollywood hills and San Diego. This 120 mile path is not line of sight, but the results do speak of success.

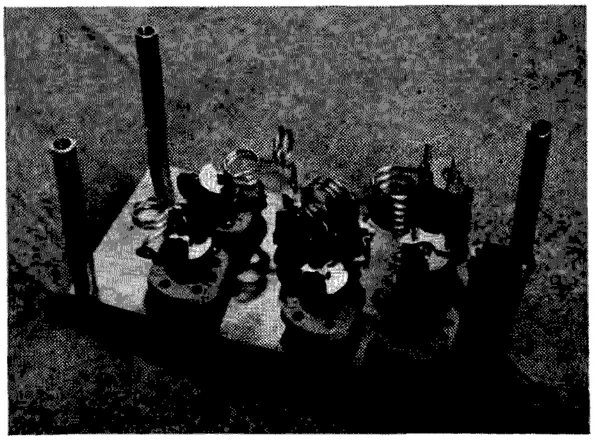
How They Work

A varactor diode is simply a semiconductor diode which uses the non-linear capacity change as related to the voltage across its junction.

The varactor is always used in the reverse or back-biased connection. This particular circuit is completely self biased however. For heat dissipation considerations the cathode is grounded. As the depletion capacitance varies nonlinearly with voltage, the input signal is heavily distorted. This distortion produces the new frequency in a very efficient manner.

In following the power flow from the transmitter to the antenna (Fig. 2) we see it first enter the filter network at our driving frequency 1F. This filter must match the transmitter impedance (50 ohms) to the diode impedance (approx. 30 ohms). It also blocks the harmonic power from being reflected back to the transmitter.

The varactor, is now creating harmonics, of which the second harmonic is predominent. This harmonic flows through the 2F trap back thru the diode; since it is being blocked by the 3F and 1F filter networks. Practically all of the 2F power will circulate through the diode and *mix* with 1F to create 3F, or in our case 432 mcs, then flows through the 3F filter and into the load or antenna.



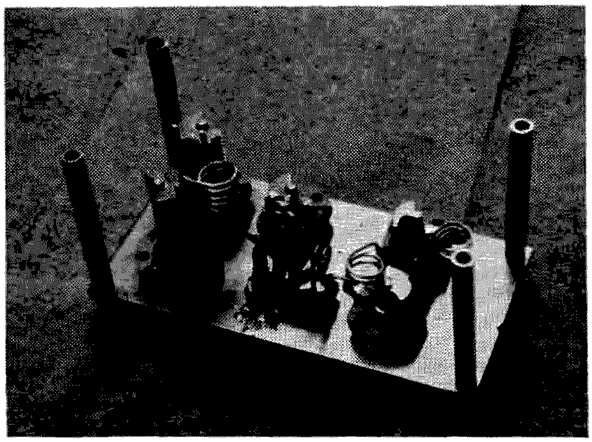


Fig. 1 Equivalent circuit of a varactor diode: Rs is the lost resistance of the diode, and is kept low for high efficiency.

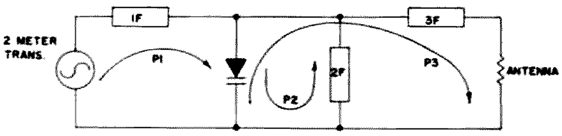


Fig. 2 Basic tripler diagram.

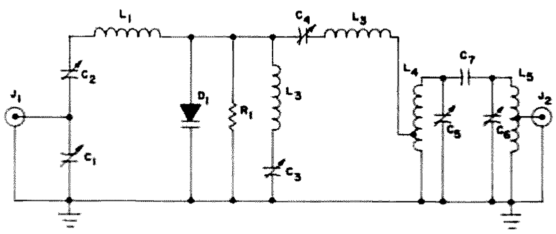


Fig. 3. Schematic diagram of varactor tripler to 432 mcs. See parts list.

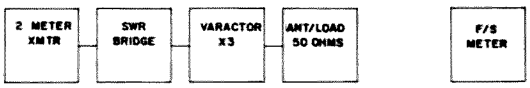


Fig. 4 Block diagram of test setup.

As usual the best efficiency can be achieved only by using good quality components and UHF construction practices. The buildup of this particular tripler should follow carefully the illustrations.

Construction

The cautious ham should have no difficulty in repeating the results if he follows the layout. If you prefer putting it on a chassis, you may do so. Make the brass board the same size as the corresponding chassis bottom plate and put the BNC connectors right next to the capacitors. Care must be taken to keep the current paths as short as possible. It may seem wasteful to break the ceramic off of the PLS6 coil form. However, this fitting grips the shoulder of the diode and provides a good heat sink. After bolting the diode mount to the board (coil form modified), puddle solder between the nut and board on the side nearest the edge. The 47K, ¼ watt resistor will also be grounded there.

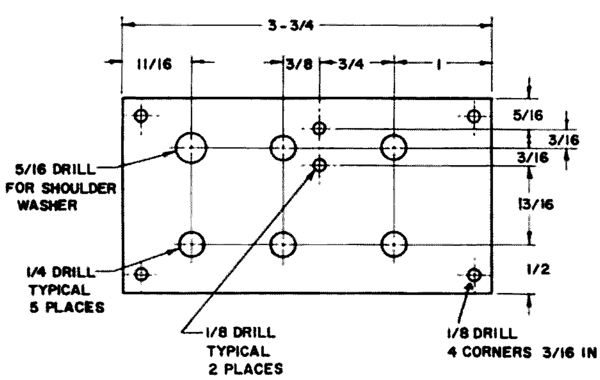
Solder all coils to their respective capacitors, leaving room on L1, L2 and L3 for the diode. You may have to spread the fingers a little after removing the tension bands from the diode holder. Gently push the diode into the holder. Solder the cathode lead to the other side of the board where it comes out. Cut off all but ¼" of the anode lead. Cautiously solder the junction of L1, L2 and L3 to this lead using no more than a 47 watt iron. You may solder normally to the lead of the diode as you would a small resistor, but do not apply heat directly to the diode shoulder.

Run a piece of #18 buss wire from the solder lugs next to the input and output capacitors, C1 and C6, long enough to reach the solder lugs underneath or directly to the body of the BNC connectors. This is to keep the ground path short for max. power out. Next, run a piece of #18 buss from the junction of C1 and C2 to reach the center conductor of the input BNC Connector. Check placement of the output BNC center conductor so that it lines up with its tap point on L5. Before you solder it in, make sure C2 is not grounded from improper seating of the shoulder washers. Insure that all solder connections are clean. Put the assembly in the box, solder the input and output connections and you are ready to tune up.

Tune-Up

A VSWR bridge is the best instrument for tune up, however a wave meter or field strength meter will suffice.

The 2 meter rig should first be tuned up at 144 mcs using a 50 ohm dummy load. Two 100 ohm, 2 watt carbons in parallel on a BNC chassis connector will do. You need not adjust the transmitter again after its tune up. Hook up the SWR bridge, varactor multiplier and 50 ohm dummy load as shown in Fig. 6, using a insulated tuning tool tune C2 for max. forward power on the SWR bridge and C2 for min. SWR. The SWR may still be high indicating that the output circuits are not resonant. Tune C4, C5, C6 for min. SWR and then go back and repeat tuning of C1 and C2. Next, tune C3 for min. reflected power. This adjustment is important so as to suppress radiation at 288 mcs, the second harmonic. It



also gives max. power out due to the mixing action. Go back and peak all adjustments for min. reflected power. The SWR should be below 2:1 with 1.5:1 typical. A wave meter or field strength meter tuned to 432 mcs can be used to peak the output and check for minimum radiation of the second harmonic at 288 mcs. Re-tune C3 for a null at 288 mcs.

Hook up an antenna and you are ready to operate. A word of caution: if you are using more than 8 watts *output,* you run the risk of overheating and destroying the diode. Also you will distort the modulation badly from overdriving the diode. If you are operating a Communicator 4 or higher power, use 2 diodes in parallel or a higher power varactor.

Note
Two'ers-Gonsets 1, 2, and 3's average 3-5 watts output. ARC-1's, 3's and SCR 522's average 5-8 watts output.

Picking The Diode

We usually don't pick our diode since some manufacturers give the hams a price break or as samples through clubs. The following is a comparison between a few of the more popular diodes used in amateur circuits. Most all are available from the various mail order parts houses.

The theoretical efficiency is figured as below:

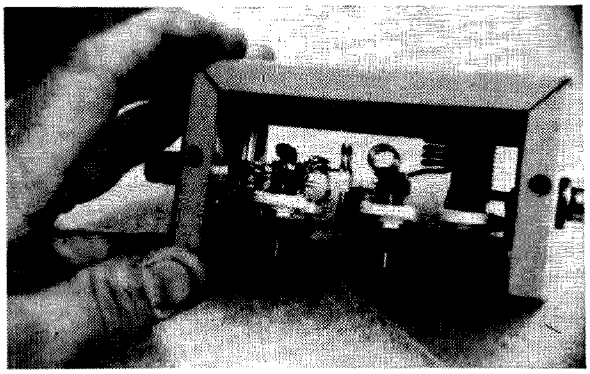
$Q = \frac{Fco}{Fin}$	MULTIPLIER X2	X3	X4
100	80%	70%	50%
60	70%	55%	35%
30	50%	35%	15%

Fin is the driving frequency. Fco is the cutoff frequency. Where Q = 1 at the voltage breakdown point Vb.
(assuming simple filters capable of 30db spurious reduction)

The prices are constantly being revised downward as more people use them. Effi-

Table I

Manufacturer	Type	Input Power	X3 Efficiency	Price
PSI	PC-116	8 max.	greater than 70%	$12.00
Microwave Associates	MA4060C	10	55%	$35.00
PSI	PV-002	16	greater than 70%	$16.00
Motorola	MV1804	30	50%	——



ciency and power handling are on the increase also. Motorola is experimenting with a pair of 1N4386's driving them with a Johnson Thunderbolt to 300 watts in at 50 mcs and getting 200 watts out as doubler.

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Bibliography

P. Penfield and R. Rafuse, **Varactor Applications**, the M.I.T. Press, 1962.

R. Gromer, **Varactor Frequency Multipliers Simplified**, personal paper, March 1964.

Parts List

C1, C2—3-32 mmfd variable (Johnson 160-130)
C3, C5, C6—5-1.5mmfd variable (Johnson 160-102)
C4—7.3-1.4 mmfd variable (Johnson Type V)
C7—1 mmfd silver mica (Elmenco DM15-010k)
D1—PSI PC-116 varactor (TRW Electronics)
J1, J2—BNC connector UG-657/U (amphenol)
L1—5 turns #18 copper buss ¼" dia. space wound
L2—3 turns #18 copper buss ¼" dia. space wound
L3—2 turns #18 coper buss ¼" dia. space wound
L4—2 turns #18 copper buss ¼" dia. space wound tap ¾ turn
L5—2 turns #18 copper buss ¼" dia. space wound tap 1 turn
R1—47K ¼ watt carbon resistor
diode holder—Cambion Thermionic type PLS-6 (see text)
tite-fit box chassis LMB J-875

The total cost of all parts is under $22.

Blow up that Meter

(Methods for electrically expanding the scales of dc voltmeters)

C. E. Miller W1ISI
85 Hammond St.
Acton, Mass.

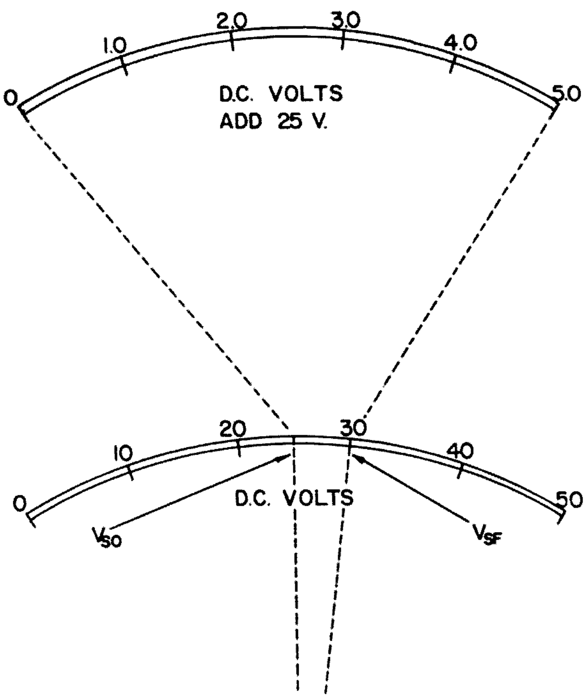


FIG. 1

Electrical expansion of a 2½" long scale to read the 25 to 30 volt dc segment is equivalent to a conventional meter with scale over two feet long.

No, not literally, although it is a temptation sometimes. Take the case of an ordinary panel meter which is used to adjust or monitor a normally constant voltage. To begin with, the meter is only specified to a certain accuracy and has only a limited scale length. The result may be a reading of questionable value and a mild case of eyestrain. As a monitor, small fluctuations from normal may go unnoticed unless one happens to be watching for them. Here again the limited scale length makes it difficult to read the magnitude of the fluctuations. We could place a magnifying glass in front of the meter scale, but you must have guessed that there is a better way. You're right. It's the offset or expanded scale meter. With it we use the entire scale length to read a small *segment* of *the total* range of an ordinary panel meter as illustrated in Fig. 1. The improved readability is obvious. It is also possible to increase the absolute accuracy of the original movement. Two of the many methods of electrical expansion of a meter scale will be outlined. Although the result will be an expanded scale dc voltmeter, the basic meter in either case may be a voltmeter or a milliammeter. The choice of method will depend on

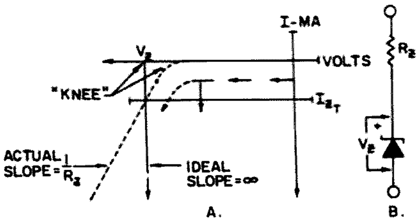


FIG. 2

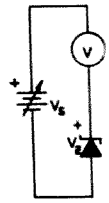


FIG. 3

Comparison of characteristics of ideal zener diode with practical zener modeled at b). Simple method for expansion of dc voltmeter scale.

the end use of the meter and the desired final accuracy.

Both methods require a source of "offset" voltage. This constant voltage is equal to or less than the smallest voltage indicated on the expanded scale. A few years ago the only relatively simple sources consisted of either batteries or VR tubes. Batteries would be charged to death and their voltage was not constant, requiring frequent replacement. The use of VR tubes limited their application to the expansion of segments of relatively high voltage. The advent of relatively inexpensive zener diodes has made meter expansion both simple and practical. Zener diodes have their problems too, of course, as we may see from Fig. 2a. An ideal zener diode would show no reverse current until the voltage across it was as large as V_z. Beyond the knee, the voltage across the device would not change regardless of the current flowing through it. A practical zener diode on the other hand is characterized by a "soft knee" and an increase in the voltage across it as the current through it is increased. The latter effect is similar to the result we would have if we placed a fixed resistance in series with an ideal zener, as shown in Fig. 2b.

The first and simplest method of meter scale expansion is shown in Fig. 3. Here a voltmeter, typically a high-resistance device, is connected directly in series with a zener diode. The deflection of the meter pointer is proportional to the current flowing through it, but this will be zero as long as V_s is smaller than V_z. When V_s exceeds V_z, current will flow in the circuit, V_z will be a constant, and the meter will see and read the difference between V_s and V_z. For the example shown in Fig. 1, we would thus use a 0-5 volt meter and a 25-volt zener diode. The disadvantages of this system are imposed by the zener diode. The actual voltage, V_z, may be as much as 5-10% above or below the indicated value. Thus, with a zener having an exceptionally sharp knee at 23 volts, a 5-volt meter would indicate a V_s of 23-28 volts. Another problem typically arises due to the soft knee or relatively large change of V_z at low current. This effectively degrades the *linearity* of the expanded scale meter at the low end. This problem is typically worst in zeners of early manufacture and all higher power dissipation types. Best results will be obtained with modern zeners in the 250- or 400-milliwatt class.

The most desirable method of meter expansion involves the use of a simple bridge circuit. Here the peculiarities of the zener diode become relatively unimportant, and we may obtain excellent linearity and accuracy. The final accuracy will typically be governed by the accuracy of the standard we employ when setting two potentiometers. Fig. 4 illustrates the basic circuit which operates as follows. Consider the circuit between points *a* and *b* to be opened at point *x*. The zener diode and R1 form a shunt regulator circuit. Resistor R1 limits the current through the zener diode when V_s is greater than V_z. Under these circumstances, and assuming the zener to have a sharp knee, the voltage at point *a* with respect to point *c* will be equal to V_z. Resistors R2 and R3 form a simple voltage divider across V_s. The ratio of these two resistances will be set such that when V_s is equal to V_{so}, the voltage at point *b* with respect to point *c* will also be equal to V_z. Thus, with V_{so} applied to the input terminals, the bridge is said to be balanced, that is, the voltage appearing at point *b* with respect to point *a* will be zero. The circuit may be closed at point *x* and no current will flow through the meter. As V_s is made greater than V_{so}, the voltage at point *a* with respect to point *c* will not change, but the voltage at point *b* on the voltage divider will increase. Since the voltage at point *b* with respect to point *a* is increasing, the meter will begin to deflect upscale. It is only necessary then to select the values of R2 and R3 to give a null when V_s equals V_{so} and to select the proper

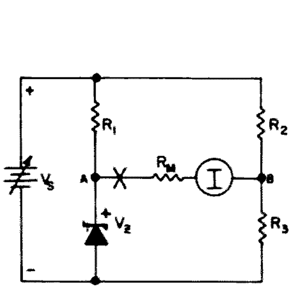


FIG. 4

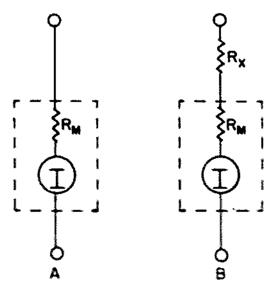


FIG. 5

Simplified schematic of bridge type expansion network. Choice of component values is considerably simplified by experimental determination of zener operating point.
Multiplier resistor R_x turns milliammeter a) into voltmeter b). Expansion of voltmeter may require removal of R_x (see text).

value of R_m to limit the meter current to the full-scale value when V_s equals V_{sf}.

A rigorous analysis of this circuit could be performed to include all the components. This would allow us to determine all values on paper. Because of the variability between zener diodes of the same type, however, rather broad adjustments of some values must be possible. Therefore, it is more practical to consider a simplified approach using less complicated calculations and based on experimental data.

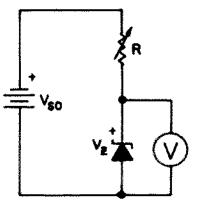
Procedure

First it is necessary to decide upon the segment of voltage (V_{so}, V_{sf}) the meter will read. There are no set rules on this as the circumstances will be different in each application. The segmental range should certainly overlap the range of normally encountered fluctuations. For example, it may be very narrow if a highly regulated power supply voltage is to be monitored. A natural benefit of expanding a meter scale by *this* technique is an increase in the accuracy of the meter. In terms of per cent, this improvement will be approximately

$$\% \text{ accuracy} \approx \left[\frac{V_{sf} - V_{so}}{V_{sf}}\right] \times \begin{array}{c}\text{Basic meter}\\ \text{accuracy}\end{array} \qquad \text{Eq. 1}$$

For a 2% meter expanded as in Fig. 1, we could then read a voltage in the range of 25-30 volts to an accuracy of 1/3% full scale. On the other hand, it must be remembered that the meter will require initial calibration, and the standard must be of greater accurary than that of the expanded scale meter.

Almost any type of dc meter can be expanded by this technique. This allows us considerable latitude in the choice of the instrument to be used. One of the most important factors is typically the appearance of the scale. That is, a meter is often chosen such that its original scale calibration has some simple relation to the expanded voltage segment. This may save considerable effort and result in a neat professional appearance. Most panel meters are of the D'Arsonval or moving coil type and therefore have full-scale deflections in the microamp or milliamp range. Fig. 5a illustrates such a meter when run barefoot. The resistance of the wire in the moving coil is represented by R_m. This same meter may be used as a voltmeter simply by adding series resistance as R_x in Fig. 5b. In order to use the simplified equations, it will be necessary to know the full-scale deflection current for the meter movement selected. This may be marked on the scale, even in the case of many voltmeters. If you are not sure, a multimeter



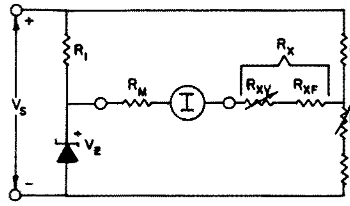


Fig. 6 Fig. 7

Circuit for determining zener diode operating point and the value of R_1.

Complete schematic diagram of electrical expansion network.

in series with the movement and a voltage source will indicate the full-scale current with sufficient accuracy. If a milliammeter is to be checked in this manner, *be sure to include a very large value of resistance in series with the source* to limit the current to a safe value. The value of resistance may then be decreased until the needle reads full scale.

The zener diode may now be selected. Here again we will make a simple experimental determination which will enable us to considerably simplify our problem. As was previously stated, V_z should be smaller than V_{so}. For the normal zener diode, a V_z of approximately 6 volts is particularly desirable. This range is characterized by the sharpest knee, the lowest series R_z, and the lowest change of V_z with temperature. If it is felt that temperature effects will be of particular importance, compensated zeners are available in the 9-volt range with exceptionally low-temperature coefficients. Their cost is greater than that of uncompensated diodes and generally will not be worth the added expense. The use of low-powered zeners is advantageous due to their low cost and because they give the appearance of having a much sharper knee at low current than units capable of dissipating much more power.

Since R1 and the zener diode form a shunt regulator circuit, minimum current flows when V_s equals V_{so} and maximum current will flow when V_s equals V_{sf}. The circuit illustrated in Fig. 6 will yield almost all of the required information about the zener diode and resistor R1. The object is to determine the largest value of R which is consistent with a reasonably small change of V_z, indicating that we are operating beyond the zener knee. We begin with a very large value of R. As the value of resistance R is decreased, the voltage V_z seen by the meter should be seen to increase. The change in V_z will become more gradual as R is further reduced. Finally a point will be reached at which further reduction of the value of R will have only a *very* small effect on the value of V_z. The value of R at this setting may be measured

with an ohmmeter, and V_z is indicated by the voltmeter. This value of R, measured with an ohmmeter, will become R1 and the voltmeter will indicate the value of V_z to be used in the following equations.

An ideal voltmeter would be one which does not draw current to load the circuit under test. The D'Arsonval meter will draw a known amount of current at full scale which is determined by its internal resistance. The expanded scale voltmeter using the same movement will draw several times as much current. This is one reason for using the largest practical value of resistance for R1. For the same reason we would like to use large values of resistance for R2 and R3. However, two important considerations must be taken into account. First, the ratio of R2 and R3 will depend upon the values of V_{so} and V_z. In addition, the impedance of R2 must be low enough so that when V_s equals V_{sf}, we are able to draw both the full-scale meter current and the current drawn by R3. A reasonable value for R2 is

$$R2 = (0.8)\left[\frac{V_{sf} - V_{so}}{I_{mfd}}\right] \qquad \text{Eq. 2}$$

where the 0.8 factor should assure that we can always obtain a full-scale meter deflection when V_s equals V_{sf}. The value of R3 is then found simply as

$$R3 = \left[\frac{R2\,(V_z)}{V_{so} - V_z}\right] \qquad \text{Eq. 3}$$

It should be remembered that the ratio of R2 and R3 must be such as to balance the bridge when V_s equals V_{so}. Either resistance could be varied slightly for this trimming operation, but it is preferable that R2 be fixed to be sure that the meter will always be able to draw full-scale current at V_{sf}.

Values for all components, except the meter resistance of Fig. 4, have now been determined. Since we know that more than full-scale current will be available for the meter when V_s equals V_{sf}, it will be necessary to add resistance in series with R_m. This resistance will also be variable and determined experimentally, so that I_m is just limited to the full-scale value when V_s equals V_{sf}. The total resistance of the meter will be greater than R_m for the milliameter in Fig. 5a, but may be less than $R_m + R_x$ for the voltmeter of Fig. 5b. The schematic of the final circuit appears in Fig. 7. Before actually constructing this circuit, it is important to estimate the maximum power that will be dissipated by the zener diode, given approximately by

$$\text{max. } P_d \approx \left[\frac{V_{sf} - V_z}{R1} + I_{mfd}\right] V_z \qquad \text{Eq. 4}$$

This power should not exceed the maximum rating given by the manufacturer. It is also wise to consider the effects of other component choices at this time. The most important factor affecting performance of the meter will be the various component temperature coefficients. The effect of the zener diode has already been discussed. The meter itself has a temperature coefficient of resistance, which cannot be altered. Fortunately, this is swamped out by the relatively large value of R_x which will be employed. For reasons of low-temperature coefficient, it is desirable that fixed resistances of the circuit be either metal-film or wire-wound types and that wire-wound pots be utilized for R_{xv} and R4. Carbon-film resistors may also be used, but standard molded-carbon types should be avoided except where the degree of scale *expansion* is small. The value of R4 should be approximately 10 to 20% of the value of R3 found from Equation 3. The value of R5 will then be given by

$$R5 = \left[R3 - \frac{R4}{2}\right] \qquad \text{Eq. 5}$$

The nearest available values for R1, R2, and R5 should be satisfactory due to the available range of adjustment of R4 and R_x.

Assembly

The expansion circuit may now be assembled and tested. The test will require the use of a variable voltage power supply and a good meter, to be used as a monitor. Typically, a 10K pot may be used at R_x for test purposes. The first step is to set the mechanical zero of the meter before any power is applied. The power supply is then adjusted for V_s equal to V_{so}. The meter is then set to zero deflection by adjustment of R4. Note that the meter will deflect downscale if V_s is smaller than

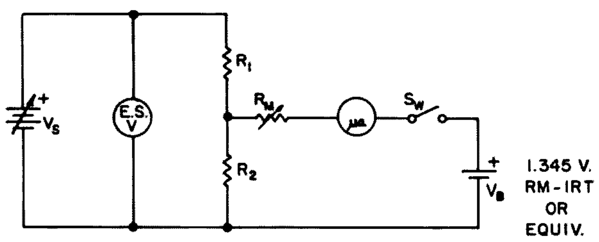


FIG. 8

Circuit for accurate calibration of meter. Resistors R_1 and R_2 should be accurate wire-wound types.

V_{so}. This is a normal condition and should cause no concern. As was previously stated, the required value of R_x may be less than the internal resistance of the basic voltmeter being expanded. Under these circumstances the internal multiplier resistance must be removed. This requires opening the meter case and usually removal of the scale plate. The meter should not be damaged if this work is done in a clean area, and reasonable care is exercised. The author prefers to short-circuit the multiplier (series resistor) rather than to remove it. The meter may then be restored to its original condition merely be removing the shorting jumper. With V_s equal to V_{sf} it should be possible to adjust R_x for exactly full-scale deflection. The pot may be removed from the circuit and its value measured with an ohmeter. If a large variation of R_x caused a relatively small change in meter deflection, then the final circuit might employ only a wire-wound pot at R_{xv}. If variation of R_x seems to have a large degree of control over the meter current, then most of the resistance in the final circuit should be in R_{xf}, a stable, fixed resistor.
The value of the wire-wound pot will then be

$$R_{xv} = 2\left[R_x - R_{xf}\right] \qquad \text{Eq. 6}$$

Calibration

The value of the wire-wound pot will then be curate only if it is calibrated against a highly accurate standard. A quality laboratory type meter may be employed if available. If not, the familiar bridge circuit may be used as an inexpensive standard. This method will give good accuracy, but will be less convenient to set up. The circuit is diagrammed in Fig. 8. The open-circuit voltage of a mercury cell is the basic reference. The voltage across the expanded scale meter is divided by a precision voltage divider, R2 and R3 and compared to the reference by a microammeter. When the calibration bridge is at null the relation between its voltages and resistances will be

$$V_s = V_B\left[1 + \frac{R1}{R2}\right] \qquad \text{Eq. 7}$$

and must be calculated separately for calibration of the V_{so} and V_{sf} points on the meter. This means that three or four precision resistors will be required. A multimeter set to its most sensitive current range and in series with a 100K or 1 meg pot will suffice as the null indicator. The circuit is first set up with the proper resistors for calibrating V_{so}. The switch must be open and R_m set to its maximum value. With V_s set to approximately V_{so}, close the switch and note the deflection of M_n. Increase or decrease V_s until closing the switch causes no deflection of M_n. Reducing the value of R_m will increase the sensitivity of the null indication. When balance is achieved, R4 in the meter expansion network may be adjusted. The values of R1 and R2 are changed to those calculated from equation 7 for V_{sf}, and the balancing procedure is repeated. The calibration is then completed by adjusting the meter expansion resistor R_{xv} for exactly full scale deflection.

. . . W1ISI

City Life (Ugh)

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Putting up an antenna in your back yard is relatively 'easy' because there is no one to stop you (except the XYL).

But if you live in one of the modern New York apartment buildings putting up an antenna may not be quite so easy—or legal. When my parents took this apartment (after living in our own house all my life) they signed a long thin piece of paper called a *lease*—WELL—it said on this unimportant little document that no tenant could put up any antennas TV or otherwise, on the roof, out the window or on the fire escape. Boy, what a position I was in.

Being the kind of person I am, I always learn the hard way

Within a couple of weeks of our arrival in Flushing (Home of the World's Fair) I had the roof of this building looking like the antenna farm you think you need 50 acres of land for. After many hours of work I was

very proud of what I had up there;
A pair of stacked seven element 2 meter beams.
beams.
A big wheel antenna.
A six meter five element beam.
A one element 15m rotary dipole.
A dipole for 80m.
A dipole for 40m.
A dipole for 20m.
A dipole for 10m.

One lovely evening after dinner the doorbell rang. My father went over to open the door and the Super was standing there. To the right of the Super was another man looking crosseyed at me. I was then informed that he was the lawyer the building had hired to take care of people who don't take care of themselves and fail to live up to the conditions stated in the lease. They both informed me that I was breaking the lease by having antennas up on the roof and instructed me to take the antennas down or I would probably get a summons from the fire department. I said to myself after they left that I would take the damn antennas down after the sked I had planned on two meters. The band was so great that night that I never got around to take down the antennas.

No one bothered me for about two months then I heard from the greatest fire department in the world (so they tell me). That night all my beautiful antennas were now down. The only things I had now was the big wheel under my bed.

In New York City apartment buildings there is an old custom that the Super of the building gets a tip from most tenants Around this time the Super is the nicest man in the world. One day my parents gave me an envelope to give the super. Upon receipt of this generous check he told me it would be alright if I put up a small dipole on the roof, he also told me that I could use the master TV antenna as a transmitting antenna. I tried to tell him that I would blackout every TV in the building out he would not listen.

After he received about a hundred complaints from potential tip givers he suggested that I put my old antennas back up and he would take care of the men from the New York Fire Department if they ever came around.

By the way the transmitter I hooked up to the master antenna was the little six meter transistorized transceiver described in the May 1963 issue of 73.

. . . WA2WYJ

Crystal Refrigerator

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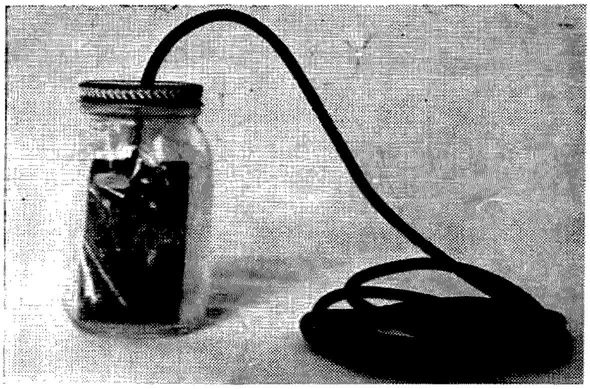
Living in apartments, particularly on the third floor as we do, has many notable disadvantages for the amateur. The lack of adequate grounding facilities and limited antenna space (or any space, for that matter) are two of the more salient problems. On the credit side, however, they're cheaper: allowing more money for equipment. They don't have lawns to mow: allowing more time for operating. Living on the third floor also means shorter cables to my 1296 mc dish on the roof.

Everything seemed fine, that is until I read about K2TKN's Ultra-Stable Xtal Oscillator (73, Feb., '63, pg. 27). Coming up with a similar oscillator wasn't hard, but running a coax line from the third floor to the ground was something else (finnicky landlord). Anyway, encapsulating the oscillator in a thermos and burying it several feet underground meant chopping through eight inches of concrete—definitely out of the question, and I couldn't afford a crystal oven (finnicky XYL).

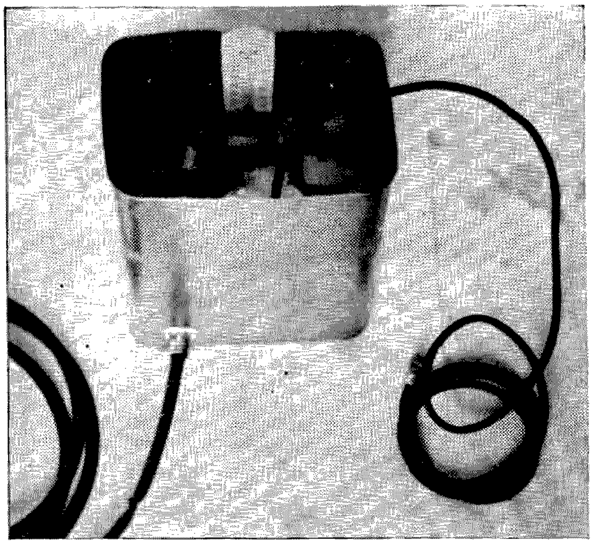


It looked like I was going to have to rely on our wall thermostat for my temperature stabilization, indeed, a sad state of affairs. Then I began thinking: look, the main purpose of a crystal oven is to maintain a *constant* temperature, not necessarily a particular temperature, but a constant one. K2TKN's idea of burying the oscillator was to utilize the near constant temperature of the earth several feet underground, not an attempt to achieve any specific one.

Not being in a fortunate enough position to use this method, I was forced to find another one, and there are other constants. The boiling point of water is one, but not desiring Transistor Newburg, I turned to another one: the freezing point of water or melting point of ice. They are both the same, but I won't go into a discussion of vapor pressures and equilibrium. When ice is melted in water, the solution will gradually reach a point of equi librium at 0° C. The temperature may vary plus or minus depending on the mineral content of the water in your area, nevertheless it will be a constant temperature.

What was needed then was a means of immersing the circuit in a bath of ice, and an enclosure to protect the oscillator. Also, it would be a good idea to have a thermometer to show that the temperature was remaining constant. As can be seen from the pictures, the only items necessary are a two gallon oil can for the ice, a mason jar to seal the oscillator in, and a convenient length of plastic garden hose with a fitting. The two little jars in the picture are the ingredients for mixing up epoxy glue.

A hole, just large enough to slide the coax through without damaging the insulation, is punched through the top of the mason jar lid. After sliding in the coax, seal around the hole with the epoxy (or rubber cement). When the cement dries, it's a good idea to screw the lid on the jar and test it in water before placing the oscillator inside. A small



fishing sinker may be needed for balast to keep the jar from floating.

The tank was made by cutting the top off of the oil can with a can opener (what else?), punching a hole near the bottom for the hose coupling, and sealing this with epoxy. The hose is used to drain off the excess water when more ice is added, and avoids the mess of trying to scoop it out with a cup. I borrowed (permanently) a large Bobby-Pin from the wife and bent it so that it could be used as a hose clamp. A shot of quick-drying copper spray paint completed the job.

Note that these are all items found around the average house and that any convenient substitute could be made. I had originally intended to use a picnic-size thermos jug, but the one we have doesn't have a large enough opening to receive the oscillator circuit. As it is, two trays of ice cubes to a gallon of water last about two hours. An open thermos could possibly double this. Temperature stability is achieved within twenty minutes, at most, and the resultant stability of the unit is excellent.

. . . K3HTB

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All About Noise Figure

"I don't believe in noise figure! The only measurement of receiver sensitivity that means anything to me is how many microvolts of signal my receiver takes before I can hear it."

This emphatic statement from a supposedly well-versed VHF enthusiast started us on a detailed examination of the whole idea of noise figure as a measurement of receivers—and we came up with some surprising discoveries, as well as no small amount of confusing data. And in view of all this, it struck us that it is again time for a detailed, *non*-confusing look at the subject.

Most surprising of the discoveries we made was that the attitude of disbelief was not unique to the one person who triggered our probe—several manufacturers, privately, admitted to sharing this opinion. It appears that, although the concept of noise figure as a measurement of receiver sensitivity has been around for nearly 20 years, it has been so surrounded by confusion that many people have simply rejected it rather than try to cut their way through the morass of conflicting data.

So let's try to cut it free of the confusion, once and for all. Ready? Let's go.

First, what is all this noise jazz anywey? We're all familiar with the fact that sometimes an incoming signal is just too weak to hear. "Down in the mud is the usual expression for such a situation. But what's "the mud?" Nothing but noise.

This noise is of the "hiss" type, rather than sputter or crash, and originates from the fact that electrons are always in motion at all temperatures greater than absolute zero. The

higher the temperature, the greater the motion. Since the individual electrons don't think, there's no purpose behind their motion—or, in other words, the motion is random.

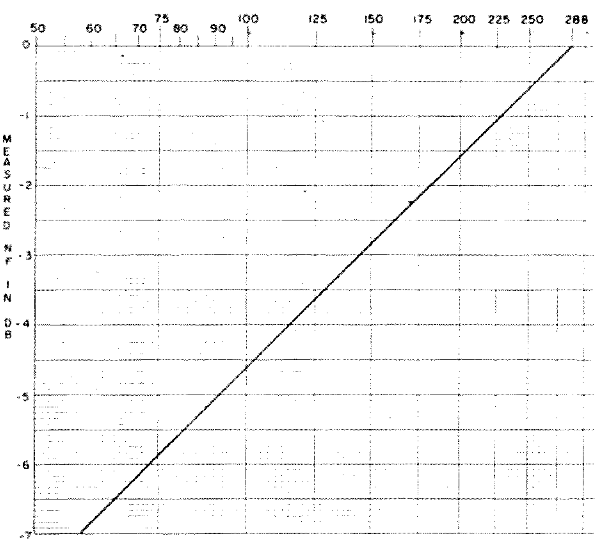
But every motion of an electron gives rise to a slight electrostatic voltage, which in a closed circuit becomes a normal voltage. The motion of a single electron results in a voltage so slight that it's of interest only to theoreticians—but any electric circuit contains millions of billions of electrons, and the total of all their votages at any given instant measures up close to a microvolt. This is well within the range of detectable signal, with enough amplification in use.

Since the motion of each electron is random, the resulting total voltage will consist of random amounts occurring at random times; it's completely unpredictable, and appears as simply a hissing sound in a speaker or as snow on a TV screen.

This "thermal noise" is distributed equally from zero frequency all the way up to (and past) the frequencies of light waves, so that no matter what part of the spectrum a receiver is tuned to, it will find some thermal noise.

And since the noise is distributed equally, it stands to reason that the wider the slice of spectrum you are listening to, the more noise you're going to get. That is, if you have all the selectivity in and are hearing a slice of spectrum just 10 cycles per second wide, you're not going to find as much noise there as you will in a slice 10,000 cps wide.

This result—the theoretical boys talk about it in terms of "noise bandwidth"—shows us what's wrong with absolute microvolts as a



Converting measured NF to apparent antenna temperature (see text). Example: If noise figure measures to be — 2.8 db, apparent antenna temperature is 150°K.

measure of receiver sensitivity.

To make it more clear, let's take an example. Suppose you have a receiver which is capable of good copy on a CW signal only 0.01 microvolts in strength; this would be an excellent receiver. If noise happens to be distributed over the slice of spectrum in which the signal is located at the rate of 0.001 microvolt per cycle-per-second of bandwidth, though, (and this is just an example—don't quote it as being fact, since actual noise is not nearly so predictable) then at a selectivity setting which gives you 10 cps bandwidth, the noise coming in will be 0.01 microvolts and the signal will be at the same level. Your signal-to-noise ratio will be 1 to 1, which is difficult copy. If bandwidth is cut to 1 cps, S/N will climb to 10 to 1. But if the bandwidth is expanded to 100 cps, the signal will be only one-tenth as strong as the noise—it will be so far in the mud that you stand only a ghost of a chance of ever telling it's there.

Now there's nothing wrong with the microvolt idea—*if* and only if the "noise bandwidth" of the receiver is specified at the same time. But without knowing the noise bandwidth, the sensitivity in microvolts tells you nothing at all!

And the rub here is that "noise bandwidth" is not the same as the ordinary bandwidth we all know. To determine "noise bandwidth" you have to solve an integral equation involving differential gain, and who wants to use calculus every time the receiver sensitivity must be measured?

Still, many people like to talk about sensitivity in terms of microvolts, since this quantity is relatively easy to measure. It doesn't hurt at all, if the noise figure is also given. Or if the noise bandwidth is given. But microvolts alone tell nothing about the weakest signals you'll be able to hear.

So how's with noise figures? The concept of noise figure was first described in 1944 by H. T. Friis, writing in the Proceedings of the IRE, and has come into wide use in the ensuing years. But can you define exactly what it is? If you can, you're doing considerably better than most people.

Even the engineers who deal with the concept daily vary quite a bit in their definitions. According to the 4th Edition of "Reference Data for Radio Engineers," page 375, noise figure is the ratio of available signal to noise at the input of the receiver to the available signal to noise at the output. According to the instruction booklet for the Polytechnic Model 904 Noise Generator, a laboratory type instrument, noise figure is the ratio of actual receiver output noise power to that developed by an ideal receiver. The ideal is not defined.

The common definition most often heard is that noise figure is the ratio of actual receiver noise to the noise of a perfect noiseless receiver. This approaches the idea but the statement itself has no meaning; the ratio it describes is N/O, and any number divided by zero is indeterminate.

Other definitions include "the ratio of output noise to input noise, divided by available power gain (4th Edition Reference Data, page 769) and "the ratio of carrier power available from the antenna to the theoretical noise power when mean noise power and carrier power are equal." And after that last mouthful, the people who don't believe in noise figure can hardly be blamed!

But the most accurate definition is the one we started with: noise figure is the ratio of input S/N ratio to the S/N ratio at the output. In a noiseless receiver, there would be no change in S/N ratio as the signal went through, and the noise figure would be 1. But all practical receivers of the conventional type introduce at least a little noise, which is added to both incoming signal and incoming noise alike, so the output S/N ratio is poorer than that at the input. This yields a noise figure greater than 1; in a very good receiver, it will be somewhere between 1 and 2.

These "noise figures" don't agree at all with those you normally see quoted, for a very good reason. The "noise figure" we are using at this point is a ratio only; it has no dimensions or units. In general use, however, this ratio is expressed in db. A ratio of 2 (in power, which noise figures are) is expressed as 3 db, while a ratio of 1 is 0 db. So the theoretically perfect receiver has a noise figure of 0 db, while a good one has between 0 and 3 db.

Now we have a noise figure in db. What does it mean? We saw earlier that the weakest signal a receiver could pick up was limited by noise, rather than by sensitivity in microvolts. We also saw that the amount of noise was influenced by the "noise bandwidth." The importance of noise figure is simply that it makes "noise bandwidth" cancel out, and thus indicates directly the relative sensitivity of the receiver.

That is, if you have two receivers side by side, and each has the same sensitivity in microvolts but one has a noise figure of 3 db while the other has a noise figure of 6 db, a weak incoming signal which is right at the noise figure of 6 db, a weak incoming signal which is right at the noise level on the 6 db

receiver will be 3 db above noise level on the 3-db receiver, and will thus be considerably easier to copy. Continuing, a signal which is right at the noise level on the 3 db receiver will be way down in the mud on the 6 db receiver, and probably cannot be copied at all.

It's important at this stage to note that the noise figure indicates the *best* performance of which the receiver is capable, and this does not necessarily correspond with the result you'll actually get in practice. In the above example, if you were trying to read a CW signal with the selectivity controls set for 10 kc bandwidth, the signal could have been boosted well out of the mud on either receiver simply by narrowing the passband to remove the unneeded bandwidth and its noise contribution. Signal to noise ratio can be improved some 17 db this way in copying CW as compared to fone.

But when both are set for the same selectivity, and both have the same gain, the receiver with the lower noise figure will hear the weaker signal, while the other one loses out.

We can see from this that noise figure in itself doesn't seem to have much meaning either—but noise figure can be given along with total receiver gain, with microvolt sensitivity, or with receiver output level, as a measure of a receiver's ability to pick up weak signals.

We really don't have to go so far to see that noise figure *alone* has little meaning; a piece of hookup wire an inch long or so will have a noise figure of 0 db, but it won't be much of a receiver. The important thing is noise figure *plus* gain.

In view of this, the high emphasis on low noise figures might seem a bit useless except for one thing. To bring out this reason, we have to sidestep a moment and look at gain and noise separately.

If a signal is relatively free of noise, and if we have a noiseless amplifier (it's not possible, but don't worry about it), then we can get all the gain we need with no trouble.

If the signal is buried in noise when our noiseless amplifier gets it, we can't do much good. The noise will be amplified as much as the signal, and the result, though loud, will be just as unreadable as ever.

A paragraph back we said the noiseless amplifier was impossible. However, if the noise contributed by the amplifier is 60 db or more below the level of the incoming signal the amplifier is for all practical purposes noiseless. The amount of noise added will be so small in comparison with the signal that we

will never hear it, and will have difficulty in even measuring it.

So the practical problem is how to get the signal some 60 db greater than the noise without adding more noise in the process. Actually, the 60-db figure is a broadcast-standard ideal. For ham purposes, where we can tolerate quite a bit of noise, 10 to 15 db is often considered enough.

Let's try an example to see how things work. Assume the signal is at a level of 1 microvolt and that each amplifier stage along the way adds 0.1 microvolt of noise. In addition, let's say that each amplifier stage has a voltage gain of 3.2, and that the signal coming from the antenna has no noise at all.

Input to the first stage will be 1 microvolt of signal and 0 microvolts of noise; this stage amplifies the signal to 3.2 microvolts and adds 0.1 microvolt of noise to the output.

The second stage receives 3.2 microvolts of signal and 0.1 microvolt of noise; it amplifies this to 10 microvolts of signal and 0.32 microvolt of noise, and adds another 0.1 microvolt of noise of its own to bring the noise content to 0.42 microvolt.

The third stage brings things up to 32 microvolts of signal and 1.35 microvolts of noise, and adds another 0.1 microvolt to the noise to give us 1.45 microvolt in the output.

Similarly, fourth-stage output will have approximately 100 microvolts of signal and 4.73 microvolts of noise. You can see that the ratio of noise to signal is continually increasing. It began at zero, was 1/32 at the output of the first stage, and by the fourth-stage output had climbed to 1/21.

But with the specific figures we have been using, the signal is still a little better than 21 times as strong as the noise after four stages. This gives us a signal-to-noise ratio of about 23 db, which isn't bad.

Let's go back and try a 0.1 microvolt input signal. First stage output is now 0.32 microvolts of signal and 0.1 microvolt of noise. Second stage output is 1 microvolt of signal and .42 microvolt of noise. Third stage gives 3.2 microvolts signal and 1.45 microvolts noise, while fourth stage gives about 10 microvolts signal and 4.73 microvolts noise. The signal is now only 2.1 times as strong as the noise, for a S/N ratio of 3 db, although it was noiseless when it entered the receiver.

We can see also that every additional stage of amplification *hurts* the signal-to-noise ratio in this case, because more noise is added in every stage.

Had the gain per stage been higher, or the noise added in each stage lower, the original purity of the signal would have been more closely maintained.

Let's see briefly how it would work with a stage gain of 10, the 0.1 microvolt input signal, and all other conditions the same as the previous example.

First stage output would be 1 microvolt of signal and 0.1 microvolt noise; second stage would give 10 microvolts signal and 1.1 microvolt noise; third stage would be 100 microvolts signal and 11.1 microvolts noise; and fourth stage would be 1000 microvolts signal and 111.1 microvolts noise.

Signal-to-noise voltage ratio at the output of the first stage would be 10 to 1. At the second-stage output, it would be 9 to 1. At the third, 9 to 1 also, and at the fourth, still 9 to 1.

Compare this with the second example. There, signal-to-noise voltage ratio after one stage was 3.2 to 1, after two was 2.38 to 1, after three was 2.2 to 1, and after four was 2.1 to 1.

And in the first example, after the first stage S/N voltage was 32 to 1, while after four stages it had dropped to 21 to 1.

This indicates that for good performance we must have good gain per stage; with the third example, the signal-to-noise ratio for a weak signal stayed fairly constant at about 9 to 1 regardless of the number of stages. In the earlier examples with less gain, S/N ratio got worse with every stage.

Before we get away from the numbers game, let's try one more example. This one is more complicated. It assumes that the first stage has a voltage gain of 20 and contributes 0.1 microvolt of noise, while the remaining stages have voltage gains of 10 and contribute 0.2 microvolts of noise per stage. As before, the input signal is noise-free, and we'll try it at the 0.1 microvolt level.

Output of the first stage will consist of 2 microvolts of signal and 0.1 microvolt noise, for a S/N voltage ratio of 20 to 1.

Output of the second stage will be 20 microvolts of amplified signal, 1 microvolt of amplified noise, and 0.2 microvolts of new noise. S/N voltage ratio is now 20/1.2 or 16.7 to 1.

Third-stage output will be 200 microvolts of signal, 12 microvolts of amplified noise, and 0.2 microvolts of new noise. S/N voltage ratio becomes 200/12.2, or 16.4 to 1.

Following the same pattern, fourth-stage output will be 2000 microvolts of signal and 122.2 microvolts of noise; S/N will be about 16.38 to 1.

Note that after the first drop from 20-to-1

to 16.7-to-1, the S/N ratio doesn't suffer applicable degradation from that point on down the line. Even after a dozen or more such stages, the S/N voltage ratio should still be better than 15 to 1, which is a db value of more than 20 db! And this will amplify stages having individual gain to noise ratios of 50.

The difference here was in the use of a high-gain, low-noise first stage. It set the S/N ratio, and the following stages didn't do much to change it.

To get back to our subject of noise figures, this means that if one stage has a good noise figure and sufficient gain, the later stages need not have such good noise figures and can be designed with only gain in mind. To put it into a bit of engineeringese, the total noise figure of two stages in cascade is equal to the noise figure of the first stage plus the quotient of the noise figure of the second, minus one, divided by the gain of the first. This formula is *not* in decibels.

This information takes care of our little piece of hookup wire with a 0-db noise figure. It has zero gain also, so if we consider it to be a stage and follow it with a noisy amplifier, the total noise figure will be (converting from db back to ratio figures) noise figure of the wire, 1, plus noise-figure-of-second-stage-minus-one divided by gain of wire, 1. Which all boils down to the fact that the total noise figure will be that of the second stage alone.

It also brings out clearly the idea that the noise figure of the first stage, alone, sets the noise figure of the entire receiver. The second stage noise figure may degrade it, if first-stage

gain is not great enough, but nothing can improve it.

And here is the importance of the emphasis on noise figure. It provides a measurement of the relative merit of two different circuits, which is not dependent in any way on noise bandwidth present, and which tells us instantly which of the circuits will degrade the incoming signal the least. By using the stages-in-cascade formula, we can avoid being trapped by the 0-db noise figures of small chunks of wire, but we will always know that a 0-db noise figure indicates a better front end than a 3-db noise figure does, and so forth down the line. And when noise figure is measured through an entire receiver, the gain problem is automatically taken care of. If noise figure measures low, then the receiver has to have enough gain to make use of it! If the gain is too small, the noise figure simply won't be low regardless of how little noise is actually added by each stage in the receiver.

So now we know what noise figure is and what its importance amounts to. But we don't know yet the noise figure of our favorite receiver. How do we find this out?

It's fairly apparent that the only way to really find out is to measure it, since calculations could at best show only what it *might* be. But how is the measurement carried out?

Noise figure measurement involves the use of a noise generator. This, briefly, is a gadget which produces known amounts of noise. Two general types of noise generator are in use today; the first uses a silicon diode or other semiconductor as a noise source, while the second uses a "temperature limited vacuum diode."

The semiconductor noise generator is fine for rapid alignment or touch-up of a front end, but is useless for noise figure measurement since its noise output cannot be determined accurately. In other words, it is a *comparison* device rather than a *measurement* device.

The noise output of a "temperature limited vacuum diode" noise generator, on the other hand, follows a known mathematical rule. By measuring the current flowing through the diode, the noise output may be calculated almost exactly.

Don't let the long name of the device scare you off; several good ones have been described in the ham literature lately, and are cited in the references at the end of this article.

The technique of making the measurement is to connect the noise generator to the receiver input but leave the generator turned off, and take a reading of the noise output of the receiver. The generator is then turned on, and its noise output increased until the noise output of the receiver doubles. Since we're working with noise *power* rather than voltage, this will be a 1.414-time increase in voltage. A more accurate method is to introduce 3 db loss in the receiver, such as between the converter and the receiver itself, and adjust noise generator for the *same* indicated output. This avoids the problems of detector linearity and meter accuracy by using the detector and output indicator simply as comparison devices.

In either event, when the noise output from the generator causes the noise output of the receiver to be double that with the generator off, it's fairly obvious that the noise generator output is at the identical level as that of the receiver's own internal noise. To put it mathematically, what plus one equals two?

And with the amount of the receiver's noise determined, you have the noise figure. To get the reading in db, you simply work the equation: $NF_{db} = 10 \log 20IR$, where I is the noise generator current in amps and R is the noise-generator impedance, usually 50 ohms. When R *is* 50 ohms, this simplifies to $NF = 10 \log 1000I$, and the 1000 can be eliminated by taking the units of current as milliamps rather than amps. Thus a reading of 4 ma on the noise generator's current meter would indicate a noise figure of 6 db. A 2-ma reading would be a 3-db noise figure, and a 1-ma reading would be a noise figure of 0 db.

A couple of cautions—for maximum accuracy, take 15 to 20 readings and use the average of all of them. Also, don't worry about fractional db, as even the National Bureau of Standards has trouble measuring any closer than a half db or so when it comes to noise figure. The formula includes a couple of approximations, which makes excessive accuracy the rest of the way useless.

In addition, if the intermediate frequency of the receiver is so low as to allow the image response to be appreciable, the measurement will include the effects of image-response noise and may be as much as 3 db lower than it ought to be because of this. Be wary of extremely low noise-figure measurements—they usually indicate that error has crept in. Typical readings should be around 3 db on 50 mc, 4 to 5 db on 144, and correspondingly higher at higher frequencies, with conventional rf amplifiers. Drastically better readings mean that something's wrong in the measurement techniques.

Now let's back up a couple of paragraphs

and throw a wicked curve of confusion—and hope we can untangle it before we finish! You'll remember that we earlier defined 0 db as the noise figure of a perfect receiver which added no noise and left the original S/N ratio unchanged. And a couple of paragraphs back we showed how a 1-ma reading on the noise generator indicated a 0-db noise figure. So what have we when the current reading is only ½ ma?

From the measurement point of view, the only thing it can be called is a negative noise figure. The formula works out to give us -3 db as the noise figure corresponding to this current reading.

But from the basic definition of noise figures, this would indicate a device which not only had no noise of its own, but stripped some of the noise off of the incoming signal—and that's hardly possible either.

Until a couple of years ago, all this would have been somewhat akin to arguing how many angels could polka on a pinpoint. But with the advent of paramps, masers, and such low-noise devices, the "negative noise figures" suddenly became of practical importance. We now have devices which, when measured in the conventional manner, do give negative noise figures.

However, this is not an inconsistency in definition, and the new devices do not strip noise off the signal. They *do* approach 0 db in noise figure, but they don't quite reach it—and barring some more breakthroughs, they won't reach it until someone figures out how to make things work at absolute zero.

What makes us come up with negative noise figures is one of the assumptions on which those approximations in the measurement formula are based. The particular one causing the trouble is an assumption that the antenna is at room temperature, and views space with approximately the same temperature. This assumption allows the simple figure "20" to be used instead of a complicated expression involving the charge of an electron, Planck's constant, and absolute temperature. But it also makes the formula fail to work right when you get near 0 db.

To keep from having to overhaul the whole concept of receiver noise figures set up in the past 20 years, the state-of-the-art people are presently sidestepping the whole question by dropping the use of "noise figure" at around the 2-db point and using "apparent antenna temperature" instead. The apparent antenna temperature upon which noise-figure calculations are based is 288 degrees Kelvin; this is equal to 15 degrees Centigrade or 59 degrees Farenheit.

Use of apparent antenna temperature also includes the effects of all types of "antenna noise," so that it is actually a more comprehensive measurement of receiving capability. However, the major use of the temperature concept today is in low-noise UHF work;

noise figure still reigns in the VHF/upper HF range.

Noise-figure calculations, whether they come out positive or negative, can be converted to apparent antenna temperatures and vice versa by the use of the accompanying graph. As a side point, effective antenna temperatures of around 50 degrees are in use today—but they require highly exotic equipment. A good paramp, however, will get to the 100-degree region.

But this talk of apparent antenna temperatures is a bit off our subject of noise figure. Let's look back and see what we've found out about noise figure itself:

Noise figure is the ratio of the input signal-to-noise ratio to the signal-to-noise ratio at the receiver output, and as such is a measure of the amount of noise which the receiver itself adds to the signal. The noise figure is usually expressed in decibels, with 0 db being the limiting case of a perfect receiver which adds no noise at all to the incoming signal; such a receiver cannot exist.

The importance of noise figure is that it provides a measurement of the relative merit of two different receivers for weak-signal use; with strong signals, noise figure is unimportant, but with weak signals, the noise figure indicates how weak the signal may be before it becomes "lost in the mud."

Noise figure can be measured by use of a noise generator whose output is accurately known; however, almost any sort of error which can occur will make the noise figure appear to be better than it actually is.

Negative noise figures can *appear* to show up during measurements of exceptionally low-noise devices, but they do not actually exist. They appear in measurement because the measurement formula assumes that everything is at a standard temperature, while in a low-noise device the effective temperature is far below the actual temperature and the noise figure measurement formula no longer gives accurate results.

And for the mathematically minded operator, here's an extra given by noise figure: when calculating range by the decibel method, (in which (a) transmitter powers are converted to decibels above one watt, (b) receiver sensitivities are converted to decibels below one watt, and (c) all path losses are put into db also; so that the final result is a string of db values to be added to determine working range) the noise figure can be plugged right into it too.

And there we have it—all about noise figure (well, almost, anyway). With this kind of

background on the subject, you need never have any fears about "believing in noise figure" again. And if you want to look for some more detailed data—goodness knows there are reams of formulae which were carefully avoided in preparing this article—you can start with the references listed below.

. . . K5JKX

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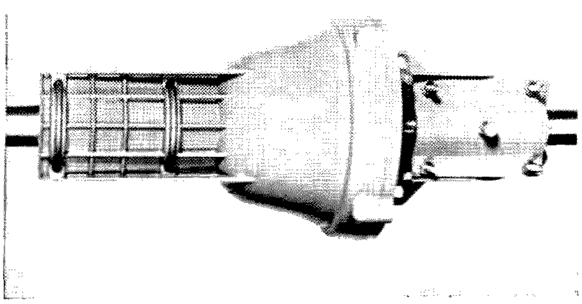
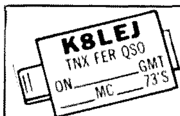
CDR TR-44 Rotator



Wayne Green W2NSD/1

Immediately I am in the soup. What do you write about a rotator? We got three of the new TR-44's for use on the mountain. We opened the boxes . . . they looked like Ham-M's. We installed them with no problems whatever in Rohn, KTV and E-Z Way towers. They worked exactly like Ham-M's, which is to say they were all you could ask for in a rotator. The only difference I've seen so far is that the 44 doesn't have an illuminated dial on the indicator. We're swinging a huge 48 element colinear-yagi beam around with one, a Hy-Gain tribander with another, and a 96 element 432 mc beam plus a 32 element 220 mc beam with the third.

They work excellently. They don't windmill. They don't do anything wrong. And the price is only $59.95. Cornell Dubilier is out of their minds to sell them so cheap.



Free Publications

For the price of a self-addressed stamped envelope you can learn the real details which others have attempted to obscure in CQ, the Washington News, and elsewhere.

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"WARN-July" . . . Ditto for their July issue. This stuff is sickening.

Conversion of the APX-6 To 1290 mc Operation

Gianni Lovisolo I1LOV
Malnate, Varese, Italy

This piece of equipment can be easily modified to make a complete transmitter-receiver set for the 24 cm band. It is ideal for mobile work, since the necessary ac, dc power supplies, the modulator and receiver audio stages can be accommodated in the existing cabinet with room to spare.

The useful parts of this equipment are: the rf section, the *if* strip, the front panel and cabinet. All the remaining (and it is much!) goes to the junk-box. The transmitter is a self excited tunable cavity triode oscillator using a 2C42 lighthouse tube. To make it oscillate on nonpulsed voltages as low as 280 volts, some form of feedback must be used; more on this later. The receiver uses a 1N21 crystal mixer, a tunable cavity 2C46 local oscillator and a 60 mc *if* strip made with six 6AK5 tubes; the original output is video so the strip must be converted for audio detection and amplification.

To facilitate adjustment, testing and trouble shooting, the converted unit is wired in such a way as to be disassembled in three main parts by just removing a few screws and unplugging two octal and one phono plug:

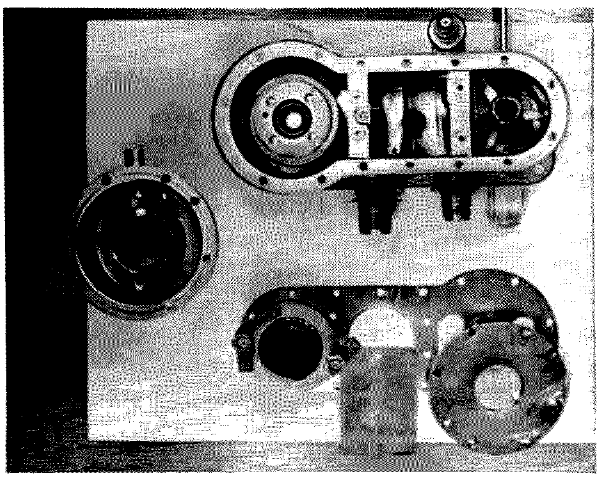
1) Power supply and modulator chassis.
2) Cabinet containing: mike input, loudspeaker, on-off sw and ac input plug.
3) Front panel containing the rf section, *if* and audio strip, switching circuit, meter and sensitivity control. Connections of rf and *if* sections go to the existing terminal strip mounted on the panel so even they can be mounted and removed with a minimum of fuss. Another advantage of this layout is that wiring is and appears "clean" and uncrowded.

Disassembly

Remove front panel from cabinet by removing the screws holding the hinges of the panel and disconnecting all wires from the vertical 12 terminal binding post. Save the screws of the binding post as this will be used later. Strip all of the cabinet save for the two fuse holders on front. Completely strip panel, putting aside rf and *if* assemblies and binding post. Now the front panel can be used as drilling template for a new panel or for a thin aluminum cover to hide unnecessary holes: see picture 7.

RF Assembly Conversion

The rf assembly is made of two parts: the lower contains the gear drive of the tuning plungers while the upper part is the main cavity body. Looking at it from the back as

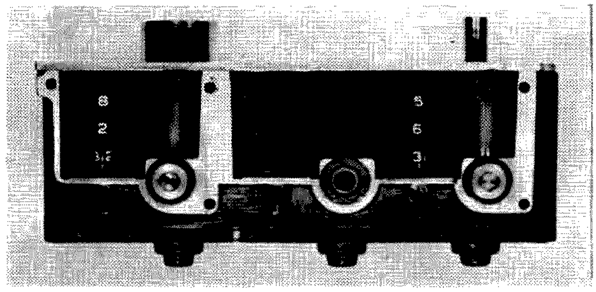


1) Modified cavity assembly: upper right, main cavity body, lower right, cover plate, center left, 2C42 cathode cavity.

in picture 5, the right hand cavity is the transmitter, the left hand one is the local oscillator, the center is the diplexer cavity, originally used as changeover switch. It contained at 1B40 tube excited by the pulsed B+ to the 2C42 tube. This cavity was detuned by the firing of the 1B40, thereby protecting the mixer diode from burnout. The diplexer must be eliminated for the following reasons:

1) Stable operation of transmitter oscillator; otherwise the 2C42 oscillates strongly only at certain settings of the diplexer cavity.
2) Receiver tuning ease; otherwise tuning would require the simultaneous setting of local oscillator and diplexer knobs.
3) Safety for the mixer crystal which easily burns out during transmission even with a neon lamp in place of the 1B40.

After modification, a partition takes the place of the diplexer cavity, providing complete insulation between transmitting and receiving cavities. This in turn requires the in-

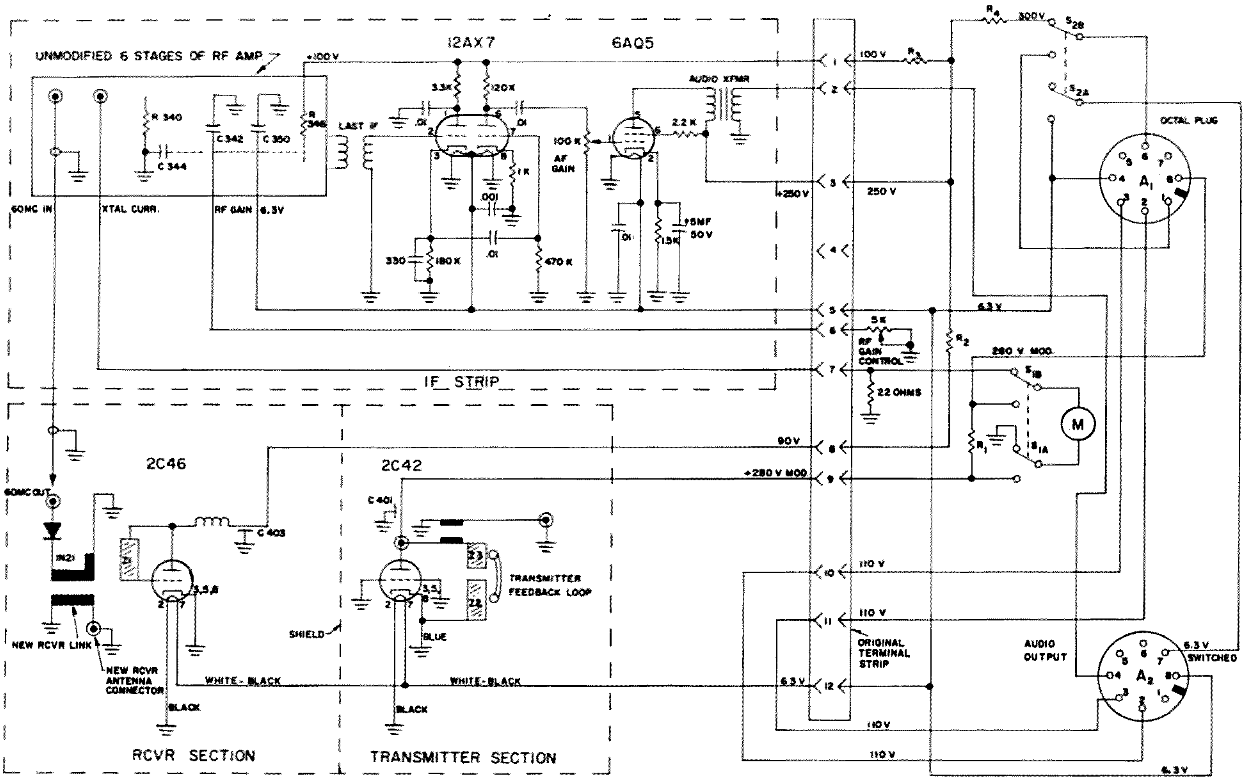


2) Gear drive tuning mechanism after modification.

stallation of a new antenna input connector for the receiver and a new input circuit. Another necessary modification is the cutting of local oscillator and transmitter plungers, since this equipment was not designed to work at this high frequency.

Mechanical

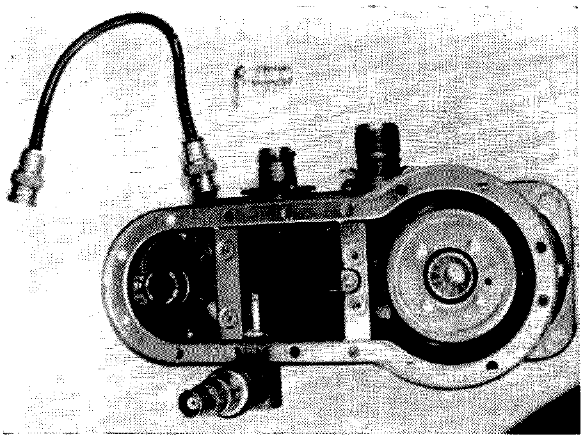
Remove the gear drive assembly from the main cavity body: see pictures 2 and 3. The gear drive has three plungers coming out from top. Remove the upper plate (plungers side), remove the back cover plate (the one with



RF ASSEMBLY

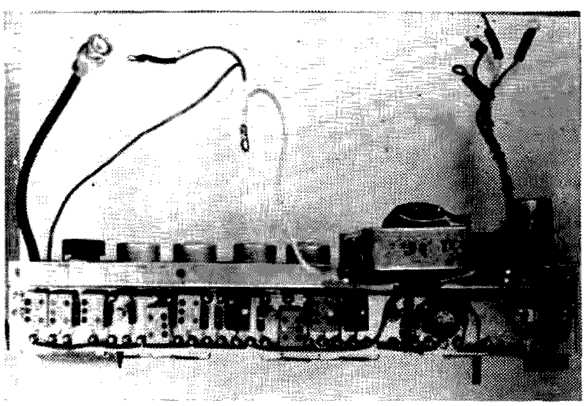
Z1 L. O. cavity.
Z2 Transmitter cathode cavity.
Z3 Transmitter plate cavity.
* All voltages marked are nominal values. They must be trimmed for best signal to noise ratio working on values of resistors R2 and R3. R1 is meter shunt, R4 adjusted for 250v.

M 0-3ma meter with shunt for 0-150ma.
S1 meter switch shown reading xtal current, other position reads 2C42 plate current.
S2 Transmit-Receive switch, shown in receive position.
A1 Octal plug, plugs into B1 socket on power supply and mod. chassis.
A2 Octal plug, plugs into B2 socket on cabinet.



3) Main cavity body after modification. Note how the receiver input link is connected to the N connector.

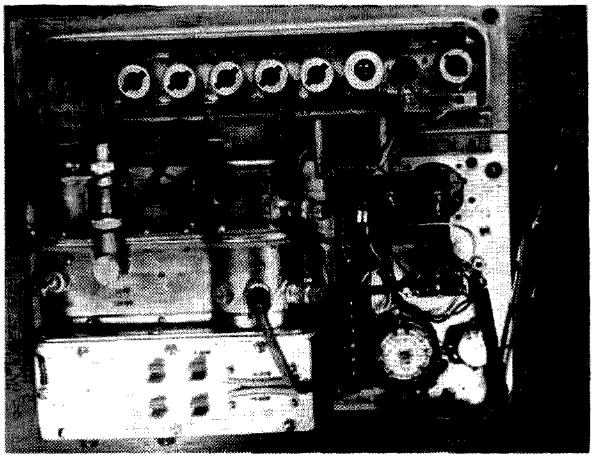
spare fuse holders on it). This done, you can see the drive gears. Put the tuning knobs back on their shafts and rotate all three to read 000 on the veeder-root dials: the plungers are now at maximum length. While turning the knobs, you will see that each of the horizontal gears has a small tab on its outer rim. When the dials are at 000, this tab holds against a similar tab on the knob shafts. These tabs make it stop at 000 and 999. Study this position carefully and, when you are confident you will be able to assemble everything back again, turn the assembly plungers down and remove bottom cover. Keeping the three horizontal gears in place with your fingers, lift the bottom cover. On it are mounted three long pins with two small tabs at the top; when reassembling, keep in mind that these tabs must go inside the corresponding slots cut on the plungers' lower body. Diplexer and local oscillator plungers are removed by pulling them out from the gear's side; the transmitter plunger by unscrewing its gear and lifting it from top. Now remove and discard the central veeder-root counter with associate gears and lock. To remove the center shaft (on which the diplexer knob is mounted) push out with hammer and thin punch the pin running through it.



4) Modified if strip now containing audio detector and af amplifier.

The best way to cut the local oscillator and transmitter plungers is to have them cut by lathe. If this is no possible, handle very carefully to avoid scratching of the very smooth surface, cut with fine toothed saw. Cut off a 9/16" length from the transmitter plunger and a 3/8" length from the local oscillator plunger. If by accident the local oscillator plunger is damaged, it can be substituted by the diplexer plunger.

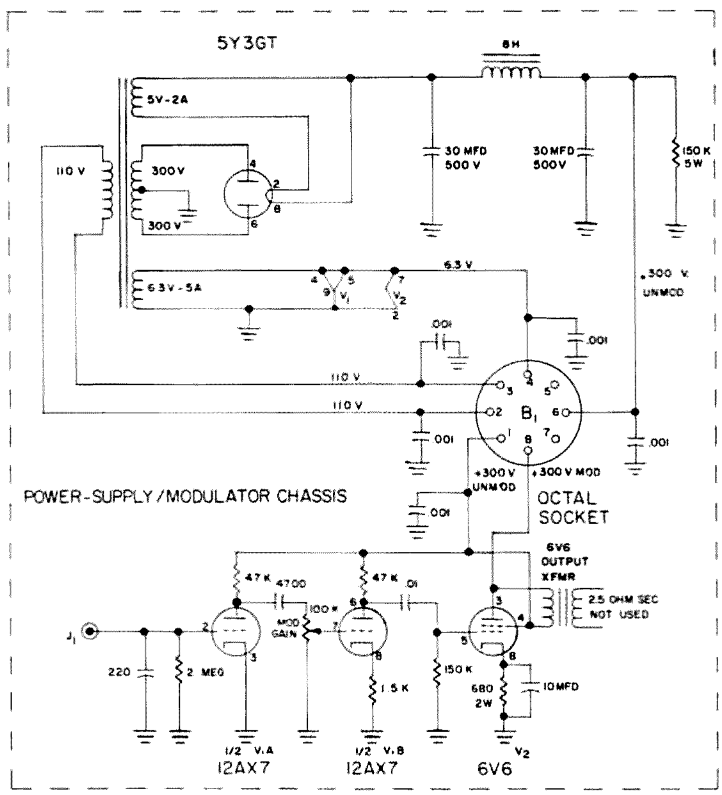
To reassemble the unit, put the two dials back to 000, if they have moved while handling, by turning their small gear. Screw for two or three turns only the gear on the local oscillator plunger and put it in its hole from gear's side; do not engage this gear with the one on the knob shaft yet. Now position these two gears to have their tabs facing, then push the plunger gear in place. The same holds for the transmitter plunger, except it must be inserted in its hole before screwing the gear on it. Before putting back cover in place, lubricate lightly all gears. Clean the two plungers with carbon tetrachloride and then put this assembly aside.

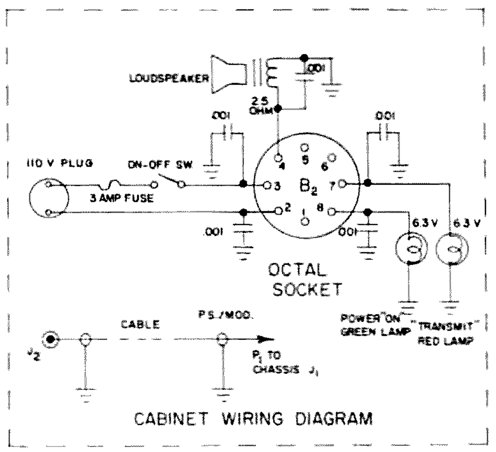


5) Complete view of back of reassembled front panel.

Electrical

Take the main cavity body and remove the 20 screws holding it together. see picture 1. Three main pieces will come apart: the 2C42 cathode cavity, the cover plate with 2C46 cathode cavity and diplexer cavity attached to it, and the main cavity body proper. Modify the main cavity body as follows (see picture 5.) Drill a ⅜" hole, centered between the B + connector hole and the right hand insulator holding the plate drum. This hole must be level with the B + hole and insulator. At this hole, solder the nut of the BNC connector





shown in picture 3. Turning the connector in this nut will provide variable coupling for 2C42 excitation. A copper shield must be installed between 2C42 and 2C46 plate cavities. Position it as shown in pictures 1 & 3. Prepare the receiver type antenna connector as shown in detail A. Now drill a 7/16" hole level with the existing transmitter connector. The center of this hole is at 1⅞" from the center pin of the transmitter connector. Solder the new connector in place. Cut the receiver antenna coupling link as shown in detail B. Solder it to the extended receiver connector tip. The other side of this link is soldered to ground near the local oscillator link; see picture 3. These two links run parallel; the exact distance between them will be found during adjustment.

Modify the cover plate as follows; remove the diplexer inner conductor by unscrewing the three screws holding it to the outer conductor. Now saw off the diplexer outer conductor. Cut the copper square to cover the hole left by diplexer as in detail C. Also cut the copper round cover as in detail D. Also see picture 1.

Modify the 2C42 cathode cavity as follows: cut away the two bean shaped objects protruding from the cathode cavity inner conductor. Trim off the square flange from a BNC connector. Now put back this cavity on the main cavity body; be careful to align the mounting holes of the flange (see picture 5). Drill a hole ⅜" in diameter on the cathode cavity. This hole, in the vertical plane, must be level with the hole with the nut soldered on it, and must be ½" high from the cathode cavity mounting flange. Now solder in this place the trimmed BNC connector; then solder its center tip to the inner conductor of the cavity by means of a small strip of copper. Reassemble all the main cavity body, leaving off temporarily the copper square.

The two octal sockets of the 2C46 2C42 must be connected as follows: black and blue wires to ground, white–black wire to 6.3 volts filaments. The blue wire is the 2C42 cathode connection; it can go to ground through a potentiometer, but tests have shown that best results are with cathode at ground potential.

IF Strip Modification

Unsolder the wire connected to the hot end of C-301, also remove the 22 ohm resistor connected between this point and ground. Now solder on this point a much longer wire; this will go to the meter to read xtal current. Connect to ground junction between R-310 and C-344. The wire connected to the hot side of C-342 goes to the rf gain control. Now remove and discard all components connected to tube sockets V-309 V-308 and V-307. Be *extremely careful* when unsoldering the leads of the last *if* transformer from V-307. Remove tube sockets V-307 and V-308. At V-307 goes a 9 pin socket for the

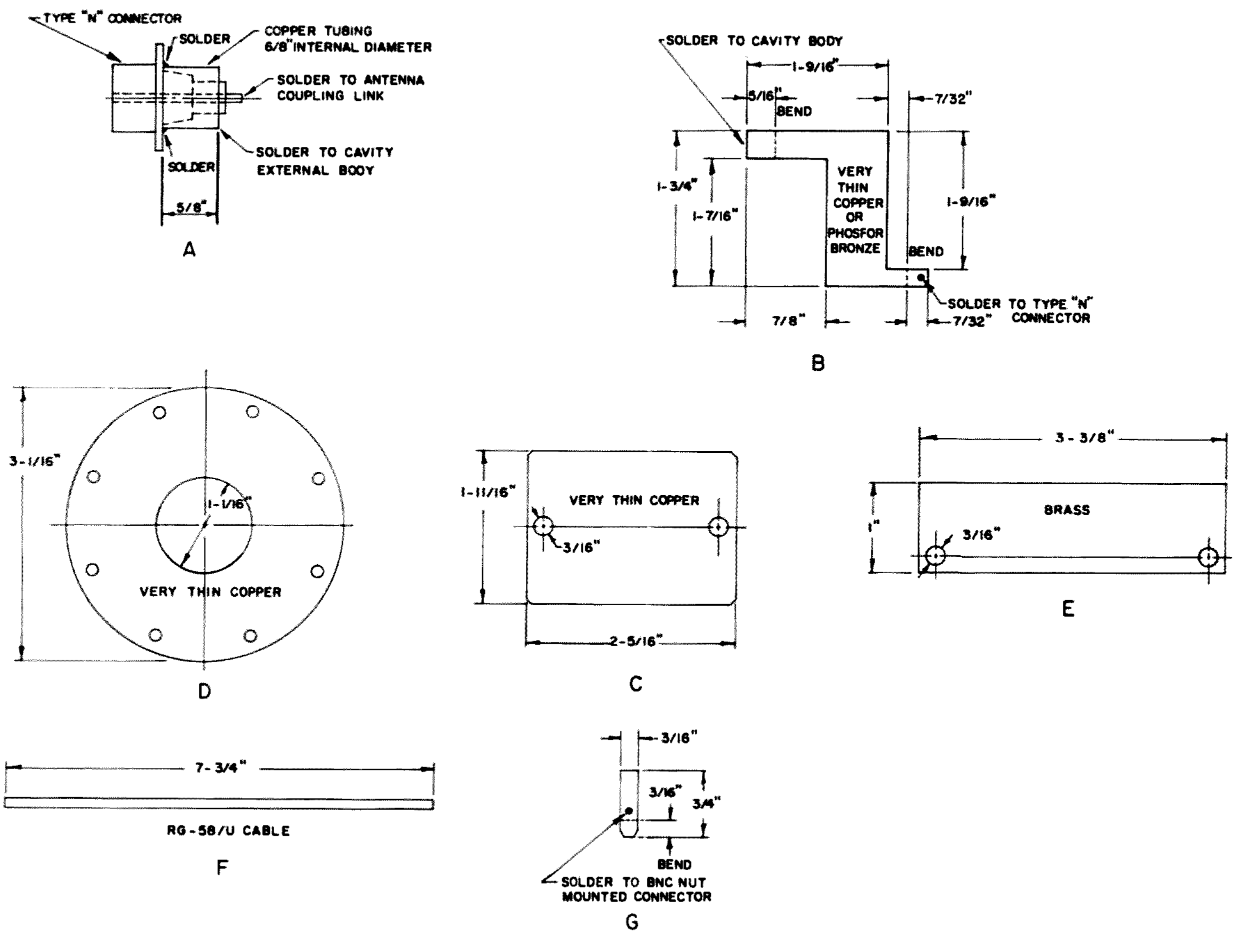
12AX7, at V-308 goes the potentiometer for volume control. Now wire as shown in schematic diagram. First triode section of 12AX7 is an infinite impedance detector, all following is conventional. This detector was the one which gave best results in this application. The audio output transformer is mounted on a brass plate as shown in detail E and picture 4.

Wiring

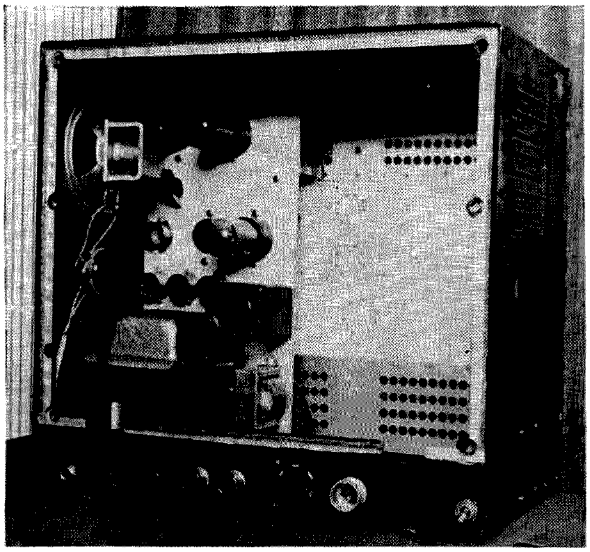
All external connections of the modulator power supply should go to its octal socket. The same holds for all parts mounted in the cabinet. Units mounted on front panel should be connected with the 12 terminal strip, and through this strip to the panel controls. Connections between front panel, power supply and cabinet should be made only through the two octal plugs. Other details in picture 6 and schematic. Using a 5½" x 12" chassis for the modulator power supply will leave space for a dc power supply for mobile use.

Adjustment and Operation

Test power supply and modulator by connecting a jumper between pins 6 and 1 of B1 octal socket on mod/pwr-supply chassis. To monitor modulator, plug a record player into J1 and connect a loudspeaker across the unused secondary of JV6 output transformer. To test *if* strip, inject a 60 mc signal to the BNC input connector. The bandwidth of the *if* should be of about 10 mc; *no attempt should be made to reduce this bandwidth* modifying the six stage 6AK5 *if* amplifier as this can *lead to a lot* of trouble as experienced by the author. With rf and audio gain controls set to maximum, sensitivity should be quite high, even with signal gen. loosely coupled. This done, connect the *if* strip to mixer output and, *while monitoring 1N21 current,* connect B+ to the local oscillator feedthru condenser C-403. Start with a value of 25K for resistor R2 after you have found the value which gives 250v at R4. When the 2C46 starts oscillating, a hiss is heard from



A) receiver antenna connector, B) receiver antenna coupling link, C) copper square cover for hole left by diplexer cavity, D) 2C42 cathode cavity cover ring, E) of out put transformer mounting plate, F) feedback loop cable for 2C42. Cable length with BNC connectors soldered on it should be, tip to tip ¾". Start with this length and trim for best results, G) feedback link for plate cavity of 2C42 tube.



6) View of cabinet and power supply-modulator chassis.

the loudspeaker. You can now lower the value of R2 to get more xtal current *which must not to be more of 1.5 ma.* Now, with a piece of wire connected to the antenna connector, you should be able to heart your 144 mc rig. Coupling between antenna and local oscillator links must be adjusted for best signal-to-noise ratio on a weak signal; the same holds for final adjustment of resistors, R3 and R2. R3 is resistor controlling *if* plate voltage; if this is too high, the *if* gets very noisy with deterioration of signal-to-noise ratio. After best coupling between the two links is found, cover the diplexer hole with copper square of detail C.

Results

Transmitter Adjustment: This is, by far, the most critical work to be done on your APX-6, since it is not easy to find the proper length for the feedback coupling loop. Apply B+ to 2C42 and a lamp or rf meter across antenna connector; while monitoring plate current, rotate the dial knob. When 2C42 starts oscillating, you should have a dip on milliammeter and rf meter pointer should move. Now rotate plate acvity BNC connector for maximum output. Switch meter to read xtal current to see if any rf is leaking to the 1N21; if the shield is well done, you should get *absolutely no reading.* Now determine transmitter frequency with lecher wires or similar methods. If it is higher or lower than 1296, you can change it by turning the transmitter knob; but, if it is out of frequency too much, the 2C42 can stop oscillating. If this happens, make a longer cable if it was too high, a shorter one if it was too low. When the rig is on frequency, trim the loop cable for best output. Plug the microphone into J2, set mod. gain to maximum and speak: you should get fairly high kicks on the plate meter with modulation applied. Remember: the stronger you modulate, the better you will be heard with this sort of rig. Plate current, with 300 volts, should be around 50 ma. This is a bit much for a 2C42, but I have been using one at this input for more than one year (leaving sometimes the rig on for one hour, or more, continously during duplex work) and it is still going strong.

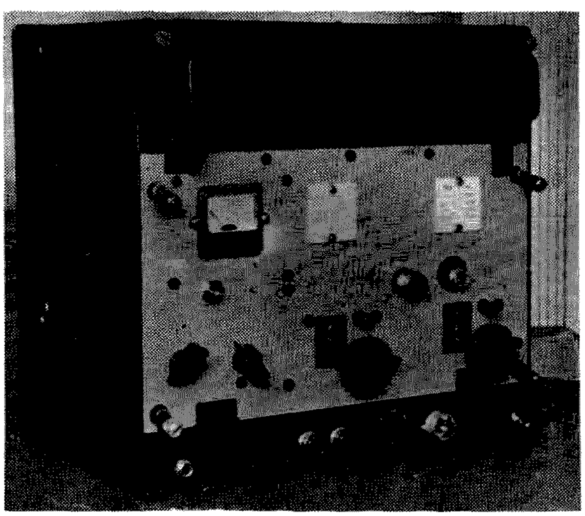
To date, four units have been so modified by the author without undue trouble. Calibration of the two dials differs much from set to set since this is affected by tubes capacity, voltages, and so forth. However, average calibration is (but do not depend on it!):

TX dial:	1276 between	875 and 915
	1296 "	930 and 970
RX dial:	1276 between	680 and 715
	1296 "	740 and 780

The most sure calibration of receiver can be made using the 9th harmonic of your two meter rig tuned to 144.000 mc.

Results

Frequency stability using these rigs at both ends (or similar wide band receivers and transmitters) is excellent. Note that during transmit all voltages are taken away from receiver and this does not affect stability in any way. The reason is the very wide *if* amplifier. You can receive xtal controlled signals without noticing any drift in receiver. For this reason, voltage regulation was first tried, then omitted as unnecessary. Using corner reflector antennas, you can expect QSO's of about 20 miles on "not in sight paths." From mountain tops, you can expect to cover about 150 miles. The author covered about 80 miles, using corners at both ends, with very strong signals. . . . I1LOV



7) Completed unit.

(Continued from page 4)
a nasty turn. If this kept up the clubs would get absolutely nothing out of the convention.

Meanwhile a new employee had been added to the Cowan staff. This chap, with his eye on a better job, saw the problems that I was having and decided to help things along. Much as I dispise the type of person he is, I will be forever grateful for his part in my future. I might have bumped along for quite a few months or maybe even years in spite of the difficulties. It is so difficult to make major changes in one's life.

He brought up the idea of starting a new magazine . . . he even thought of the name. I laughed at this for I knew that there was virtually no way to get a new ham magazine started. Educated estimates ran to about $500,000 to get something like that off the ground . . . and the low price of QST advertising put a lid on the profits that could be made. Absurd.

He didn't give up that easy. He visited the Cowan office one night and came up with copies of the company financial statements. I was flabbergasted to find that CQ and our other books had made a net profit before taxes of over $100,000 the previous year! This particularly burned me when I remembered the $5 Christmas Bonus, complete with note saying that Cowan wished it could be more. Another little gem was copies of the circulation records for CQ. I had been trying in every way possible to find out how the magazine was doing. I wanted to see if there was any correlation between special issues and circulation, etc. The answer was always the same . . . "sorry, you can't see the circulation records." When I got a look at the actual circulation and thought back to the sworn figures that were shown to advertisers I was dumfounded . . . and I understood why these were so secret.

I didn't have long to worry about this though. The next morning Cowan was in a frenzy and demanded the circulation figures. My friend had told Cowan that I had them, but neglected to tell him that he had given them to me. I left and he got that better job. Cowan apparently assumed that I was the one that dug them out. He promised to pay up my expenses, royalties, etc. I haven't seen a nickle yet. I'll not hold my breath. Cowan, I hear, eventually found out that he had been duped and fired the fellow.

It was a tremendous relief to get out of that situation. If only I had had the courage to leave two or three years earlier when I saw the handwriting on the wall.

I went to work for one of the largest ad

agencies on Long Island and got together with the Hudson Amateur Radio Council, which was just being formed at that time. I pitched in with them to put on a convention and before long Cowan had to announce that CQ's convention was canceled. I must admit that I read that with considerable satisfaction.

After three months of being an account executive I knew that this just wasn't what I wanted. Sure, I could easily make twice my salary at CQ . . . but I wanted to be back in the ham business. I decided to see what I could do about starting that new ham magazine.

After several weeks of visiting amateurs who might be in a position to bankroll me I found that I was the only one the seemed to have any confidence that a new magazine could be successful.

It was time to make a decision. I figured the absolute minimum that I would need to get started and found that if I sold everything of mine that I could I might just barely make it. I found a tiny furnished office with very low rent and invested in a Ditto machine. Letters flowed out to authors inviting manuscripts and guaranteeing payment on acceptance. No longer would an author have only a choice of no payment at all from QST or a long long wait from CQ. The response was encouraging. Excellent manuscripts began to come in.

Next I wrote to every club I knew of and invited subscriptions. My reputation at CQ paid off here as pre-publication subscriptions poured in.

The first issue, by virtue of subscriptions and, the support of many advertisers, was in the black. It has been a slow building process since then. I've probably made a lot more serious mistakes than I should have, but we're growing all the time and we're still in the black though just barely.

So much for history. I thought you might be interested in some of it on this fifth anniversary of my starting 73.

As you know, when I started 73 I put in many changes that I had wanted to make in CQ. We concentrated on articles and left the operating news stuff to QST. The emphasis was on simple construction projects and technical articles for the average ham . . . not the engineer.

Then, last year, the growing internal problems of the League resulted in their proposal to the FCC, RM-499. I could see the future of our hobby in jeopardy unless someone had the guts to speak up and try to stop things. The situation was far more serious than almost anyone recognized. I looked around and there was no one else to speak up. It had to be me.

My editorials have been strongly worded. Oh, I try to be unemotional about these things, but I can't really because I am in love with amateur radio. I don't know how else to explain it.

Let me give you a little thought. The other day I was sitting up on the mountain working fellows on two and six meters. It was like being at a huge cocktail party where I could turn in any direction and enter into a conversation with anyone I wished. I was in the middle of a world full of people all having a good time. Then I turned off the "big switch" and there I was all alone in the fog and rain up on the side of a mountain in remote New Hampshire with no one else for miles around.

Ham radio is like that. No matter where you are you have friendly people to talk to as soon as you get on the air. While in Los Angeles a few days ago I got on the air from WA6JNO and immediately the air was filled with people saying hello to me from Hawaii, Wake, and around Los Angeles. It brought a warm friendly feeling.

I ask the forgiveness of those of you to whom amateur radio is just a hobby . . . or a service. I'm in love. I love to work DX . . . I love two meters . . . I love six meters . . . I love rag chewing . . . I love to build equipment . . . I love converting surplus . . . I love contests. Yes, I even love writing this goddam editorial. I'm going to do everything I can to protect my love. I'm not going to let prestige-hungry ARRL directors and the bad management they have bequeathed us continue without a battle. I'm going to work as hard as I can for the success of the Institute, which I feel is the great ray of hope for the salvation of amateur radio.

It pains me to read the attacks on me in CQ, Huntoon's Dirty Letters, and their satellite Washington News. It pains me even more when I get letters from readers who believe these people. When this happens I know that my typewriter has failed me . . . that I have not communicated what is going on. This is my fault and I know it. A great deal of the problem is my terseness . . . I must learn to to explain things more carefully.

For example, while visiting California I was the guest of several radio clubs. Members and local League officials came to hear me and to torpedo me. They admitted it. By the time I got through explaining what was going on in detail the torpedos never came. I had a hard time getting away after meetings and I want to thank every one that attended these meetings for the encouragement they gave me and the great friendliness they showed (after the

meetings) (hi).

So, here I am, the self-appointed savior of ham radio . . . the Mr. Hornblower, as W8HHS calls me. I hope you don't mind me volunteering for this duty . . . and I hope you'll join me up on my soap box. This is a big soap box and it's lonely up here.

Skunk

A club in California called the other day and offered to fly me out to talk about current amateur events They then tried to get Bill Orr to debate with me, but he begged off, adding that being near a skunk, some of the smell is bound to rub off. He suggested West Coast Director Harry Engwicht W6HC Harry choked a little when he heard the proposition and said he had a previous engagement, though no date had been as yet mentioned Next they called Huntoon He couldn't give an answer until he consulted his "superiors" After the debacle at Harvard last spring when Huntoon and Baldwin came up to debate and ended up refusing to answer any of my questions, I can see why they would rather eat nails than face me.

K3IOP

Inspite of muddled reporting in other ham magazines, the K3IOP case has been settled satisfactorily with an Order by the FCC granting Seaman an unrestricted General Class License. In 1963 he had been issued a General license which had a condition prohibiting operation in the 50 mc band.

Goodby 73 Mountain

It has been a lot of fun operating up on "my" mountain, but the time comes when I really have to be practical. I can see now that I am not ever going to have enough time to do an adequate job of setting up and operating from up there. Between 73 and my many other half and quarter baked schemes I do very well to get up there once a week, which means that I only get on the air about 30 nights a year. Weighing this against the investment makes it obvious that I am being impractical.

This would be a great spot for someone with the time to set up on 220 and 432, as well as the lower bands, for you have a pipe line right down into New York and Philadelphia. I wanted to hit all bands up to 1296 . . . I even have a small dish for it and a converted APX-6 as a starter. I wanted to be on 432 mc TV, and have the camera to prove it. Now, after two summers of having the place, I admit, even to myself, that I can't even see far enough ahead to when I would have time to pursue these interests.

The mountain is only about an hour out of Boston and some four hours from New York

and it is a gorgeously beautiful quiet and remote vacation spot. From the front porch you can see for over a hundred miles. Sigh.

In Unity There Is Strength

Several ARRL officials have been bringing this tried and true (?) cliché into play recently. This is a dandy for people who think in terms of slogans instead of thoughts. Even a moment's reflection should recall the extensive use of this phrase by Hitler. It is essentially an unarguable truth, unless one decides to try to apply it to specific situations.

What is meant by unity? If this means that all 260,000 amateurs should get together and work for some common goals than I am 101% in favor. But what do we do about the fellow that doesn't want to work for those goals . . . the lazy ham that excuses himself by saying that he doesn't have the time for our goals . . . and besides, they weren't his idea anyway. Do we force him to conform or let him do what he pleases? And what happens when 200,000 of the 260,000 decide the same way?

Or 259,000?

Does Unity mean that everyone should ignore what ARRL HQ did to WA2USA, K2US, WØJRQ, WØGZD, W2BIB, and others? Shall we turn the other cheek and lengthen the list?

Perhaps Unity means that everyone should join the IoAR? A great many problems arise in the forming of a new organization and it is indeed fortunate that the Institute has not grown any faster than it has already. Any large influx of members would paralyse things.

Or does Unity mean, "Shut up and do things our way."

VHF Contest?

Though activity in the CQ VHF contests has seemed to have been dropping off more and more with each succeeding contest, I thought I would give their August one a try. After two hours of contesting on both six and two meters I gathered that no one else on two meters was taking it seriously and about three on six were trying with any enthusiasm. Of course I could only hear what was going on in the New England-New York-Philadelphia areas and there might have been all sorts of activity out in Ohio or California.

Somehow it just didn't seem reasonable to spend twenty four continuous hours in a contest with two or three other fellows.

Channel A

The initial response to my suggestion last month to put CB gear up on ten meters on a calling channel of 28.6 mc has been encouraging. I hope to be set up on that channel on 73 mountain before long myself.

I have more than a little reason to believe that the FCC intends to make the new CB regulations stick. I won't spill the beans on how they are going to do it, but it'll be something you'll not forget soon . . . and something that will make a very strong impression on any CB'ers who think they are going to ride out the new regulations, hamming away.

Though the CB manufacturers I've talked to minimize the impact of the new regulations, I can't help but think that quite a number of the approximately 80% of those now hamming on eleven will get discouraged and want to dump their gear. We may find some mighty fine ten meter gear available for peanuts in a few months. Eventually there may be even more CB licensees than there are today . . . but obviously activity on the channels will be much lower than now. We may find some CB manufacturers turning to ham manufacturing while the slack created by the present mob leaving is taken up by the new users of the band, a slack which could take several years.

Fortunately the ham market is coming back to life after the crushing blow of RM-499 last winter. It has been estimated that something over $6 million dollars in ham sales have been permanently lost due to this blunder. Full confidence in the future of ham radio cannot be regained until the FCC acts to turn down this petition.

Besides our getting cheap equipment for ten meters there is one other beauty of the new CB regs . . . magazines, such as S-9, which have been encouraging hamming on eleven, will probably fade away.

FOR SALE

Summer vacation camp and excellent VHF location combination. Six room lightly furnished wood paneled house, four acres, over 2,000 feet up Mt. Monadnock in southern New Hampshire. Complete with four towers and antennas (16 element colinear and 10 element yagi for 6M; 288 element colinear-yagi for 2M; 48 element colinear-yagi for 2M; 32 element colinear for 220 mc; 192 element colinear-yagi for 432 mc; Hy-Gain tribander for 0-15-10M). Shower, water heater, electric stove, refrigerator, etc, Almost completely isolated . . . no TVI for miles. Built by millionaire and shows it. $21,500 (a steal). Write or call 73 for additional information.

NEWS OF THE INSTITUTE OF AMATEUR RADIO

The Institute of Amateur Radio was created to enhance the amateur radio fraternity, both nationally and internationally in scope. It also encourages improvement in individual operating techniques and individual technical advancements in the state of the art of amateur radio communications.

Now is the time to join the Institute of Amateur Radio. A lot of leg work has been done by the General Secretary and the Interim Board of Directors to get the organization on its way. The organization is feeling its growing pains. It is expanding rapidly and concurrently with this growth, greater effort has been expended to firm up rules, regulations and organizational lines.

Fellow Radio Amateur—give serious thought to your becoming a founding member now and placing yourself in the position of sharing, in the near future, responsibilities for the operation of the growing organization down to area, state and club functionaries.

How to Join

Write to the General Secretary, Institute of Amateur Radio, Peterborough, New Hampshire, and request the brochure which includes the application form.

What the Directors Are Doing

Recently the General Secretary traveled to the West Coast to discuss and coordinate affairs of the IOAR. Subsequently, with the benefits of combined thinking and inputs from these Directors, a meeting was held by Directors on the East Coast to weld together all thoughts and ideas for the conduct of business activities for the fall and winter period. This includes the drawing up of the constitution and bylaws for the ratification by the IOAR membership. Also on the agenda is the expansion of the bylaws to designate the positions and titles of officers and qualifications for office holders, and to delineate the finite lines of organization and control down to the State Director or Representative level, to include major objectives within the scope of each level. This is a big job and cannot be accomplished overnight. Progress, however, is being made in these directions.

Many Volunteers

Scores of letters have been received both at the office of the General Secretary and at the Washing-

IoAR News —*cont'd*

ton office from individual radio amateurs, members and non-members, volunteering their services for the promotion and enhancement of the IOAR organization. To those of you who have not received replies to your fine letters, let us ask you not to be discouraged, as all the mail will be answered, and the information you supplied and the qualifications stated are being categorically filed in order that interim and future requirements may be supplied from these sources. Members of the Washington office have been assigned the task of replying to your letters. Please be patient with us. It cannot be over-emphasized that your genuine and sincere interest is truly appreciated.

Dues Study

The Board of Directors at present is studying the economics of the Institute at its present level and is forecasting costs of future operation as opposed to future potential resources. A serious consideration is underway to retroactively reduce annual dues and to include with such dues a tangible, direct benefit that the IOAR members will immediately apreciate. Appropriate announcement will be made when a decision of the Board has been reached.

Milestones and Goals

Looking back over the past 18 months, it has not been an easy road. It takes money to establish and promote a new organization. The founding membership dues were established at $10.00 in order to effectively promote the Institute. The first financial statment has been sent to the members. Without going into details, funds have been spent for such things as membership certificates, dues cards, postage, stationery, brochures, banners, buttons, paper stock, reproduction charges, labor, and financial assistance to radio amateurs involved in legal cases pertaining to the operation and maintenance of an amateur radio station.

Now that the Institute is bordering 1,000 members, an established goal has been set at 10,000 by July 1965.

A Real Accomplishment

The Institute of Amateur Radio has now established a registered lobbyist to function on behalf of the Institute and to carry out instructions of the Board of Directors in connection with legislative matters concerning amateur radio or its related activities, with Members of the Congress of the United States. The registered lobbyist resides in the Washington area.

Food for Thought

It is the dedicated aim of the IOAR to maintain a truly democratic organization in which members may consider themselves as individual representatives having a voice on important policies and other matters affecting the status or preservation of amateur radio. These facts will be borne out in the constitution and bylaws soon to be released.

If the geopolitical situation remains at its present level there will be, in all probability within the next three years, an International Telecommunications Union Convention for the review and reestablishment of the world radio frequency allocations and assignments. It is the goal of the IOAR to secure enough economic strength to be placed in a position to be recognized and to be heard in connection with the acquisition of additional amateur radio frequencies and/or in the defense of the existing amateur radio frequencies allocated within Region II.

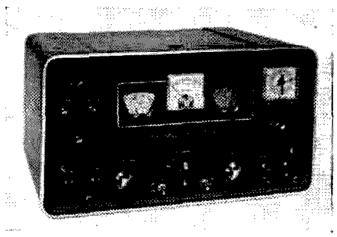
A growing concern of the Institute of Amateur Radio is the witnessing of a recent ill experience of crass commercialism within the sphere of the amateur radio hobby and service. It appears that amateur radio per se has been linked unnecessarily but by design with two well known manufacturers. In some areas there is evidence that amateur radio has become a testing ground for the professionals. While we do not wish to 'cut off our nose to spite our face,' it must be borne out that the amateur radio spectrum should be utilized by radio amateurs and for radio amateur operations and controlled as such by the FCC as a purely amateur spectrum, except for bona fide Government sharing of frequencies. The portion of the radio spectrum assigned to radio amateurs is fully justified in the United States and its possessions by FCC Regulation 97.0, *Basis and Purpose.* This paragraph alone, of the Regulations, is the crux of the justification for amateur radio operation upheld by the U. S. Government at International Conventions, notwithstanding important national defense considerations. Let no one threaten this amateur privilege through mercenary actions and selfish exploitation of the amateur radio hobby and service. In further substantiation for the existence of amateur radio in this country, one cannot overlook the economic factor in connection with the free enterprise system of our country. In this respect the hobby of amateur radio does support a share of the gross national product. Where does the IOAR fit in? The IOAR intends to influence the binding together of all radio amateurs for the common good in support of amateur radio and for the protection against an encroachment by the commercial services to potentially enter upon currently authorized amateur frequencies. The IOAR, as a body of amateurs, intends to guard against greedy, mercenary influences and the exploitation of the radio hobby by those few who would divide the multitude and the ranks for personal gain and other convenient reasons benefitting only to a minority. The IOAR concepts are to steer the generation of ideas and proposals through its membership. What say you?

Edwin M. Schaad
Director, IOAR
WA4PDX/W9AIY

How to Join

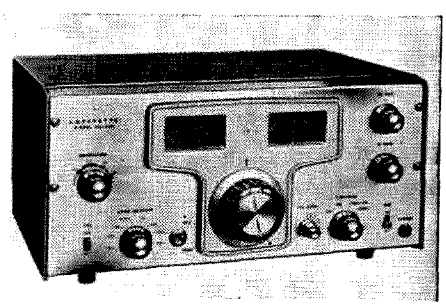
Send your name, call, address, and $10 dues to Peterborough, N. H. You will receive your membership certificate, membership card and insiders' newsletter in a few days.

New Products



HQ-145A

Hammarlund has added some important improvements to their very popular 145. The "A" now has separate detectors for AM, SSB, and CW, improved electrical and mechanical stability, silicon rectifiers (for much lower heat and higher effiiciency), and 115/230 volt operation. The price is $289! More info is available from Hammarlund, 53 West 23rd Street, New York 10.



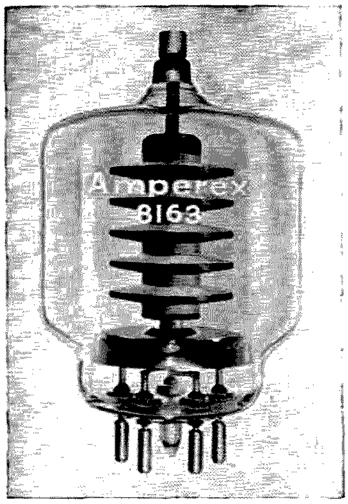
Lafayette HA-350

Lafayette Radio Electronics Corpcration, 111 Jericho Turnpike, Syosset, L. I., N. Y. announces a new ham radio receiver, Model HA-350. One of the most important features of this unit is the use of a mechanical filter in the 455Kc IF section offering high selectivity of 2KC bandwidth at 6 db down and 6 Kc at 60 db down. A tuneable preselector circuit gives a sensitivity rating of less than 1 microvolt for 10 db signal to noise ratio. The 100 Kc crystal calibrator and 15Mc WWV band provision assures accurate calibration. SSB reception is improved by the use of a product detector which provides selectable upper or lower sideband. It measures 15W x 7½H x 10" D. The net price is $189.50. Its matching speaker model HE-48 sells for $7.95.

Squalo Tree

Cushcraft's Squalo antenna turned out to be an instant success. Now they're stacking the Squalos starting with the 40M one on the bottom and going on up to 6M on top. The whole works is only 27' high and 16' wide. If you leave off the 40M Squalo it is only 11' high and 8' wide. Write Cushcraft, 621 Hayward, Manchester, N. H.

Short Treatise for Curious Hams and Amperex Stockholders



Amperex has been coming out with new transmitting tubes faster than we can count them these days. One of the many interesting ones is the 8163. All of you that use linears with bias and screen supplies can read the specs and weep. It's a high mu power triode for use as a zero bias class B linear in sideband applications up to 110 mc. Dissipation is 400 watts and as you can see from the photo, the anode is very rugged. A cheap low velocity blower will keep it happy; no need for an air system that could be used for testing a Boeing 707. Drive requirements are modest, distortion is very low and efficiency is excellent.

One of the most popular VHF tubes around these days is the 6360. This little dual tetrode is self neutralized, very easy to drive and has a respectable output. Amperex, who introduced the 6360, has announced some new extensions of its family. The 8457 is very similar to the 6360 but is especially suited for frequency multiplication. The 8458 uses a Novar base and can provide 30 watts at 175 mc with only one watt of drive. Like the other tubes, it is internally neutralized and hence very easy to handle.

Most of us will agree that transistorized equipment has many advantages over tube equipment. Even the spark boys are getting interested in semiconductors. But respectable output at practical cost now requires that you use tubes in the output. This hurts since most tubes draw large amounts of filament power even when you're not talking. Amperex has a complete line of transistors for transmitting, and now they're rapidly bringing out the instant heating tubes to use in the driver and

Letters

Dear Wayne,

In regard to the SB-400 article you published in this month's "73," I have further information which you might like to pass on to your readers.

When the SB-400 is used in conjunction with its companion receiver the SB-300 in the separate transmit/receive function and the CW mode, one is able to detect a very faint 1 kc note while receiving. At first I believed this to be the sidetone oscillator running continuously. It turns out, however that the carrier generating circuit which does run continuously in the SB-400 is feeding its signal back to the receiver product detector via the MUTE and ANTI-VOX connecting cables. The following procedure was used to affect a sure cure:

1) Connect a .005 mfd disc capacitor across the ANTI-VOX jack at the rear apron of the SB-400 chassis.
2) Remove the grey wire from the MUTE jack also on the rear apron of the transmitter. Connect a 300 uh (value not critical) rf choke in series with the grey wire and the MUTE jack it was formerly connected to.

William J. Hall K1RPB

Dear Wayne,

The members of the Radio Amateur's Explorer Post 73, of Abilene, Texas are in the process of equipping a small trailor for emergency communication purposes. We plan to have a complete ham shack with its own power source.

We've held several car washes in an effort to acquire the neccesary equipment, but these haven't produced very good results. So now we are making an appeal for contributions. Anyone that would care to contribute a piece of equipment, whether its in working condition or not, or would like more information on our project may write to;

Earl Bradley—WA5CWZ
1765 Jackson Street
Abilene, Texas

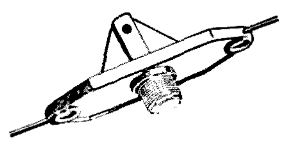
We can't offer anything in return to any contributers except possibly a note every once-in-a-while on how our project is progressing, but we will certainly appreciate any help we receive.

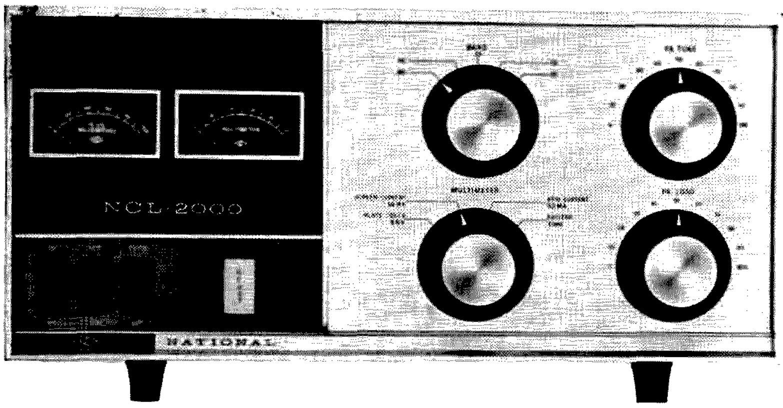
Earl Bradley WA5CWZ

Amperex . . . cont'd.

final stages. These tubes use the "Harp Cathode" that provides quick heating with low current drain, yet provides sufficient emission for efficient operation. An example is the 8463. It delivers 6.7 watts on 6 meters and over 3.6 watts on 2 with only 1½ watts of filament power. It is particularly useful as a driver for higher power instant heating finals. Another is the 8343, very similar to the popular 6360. It can put out 16 watts at 200 mc. The 8509 is the instant heating version of the 5894 dual tetrode. It is self neutralized and will deliver 96 watts to the load at 250 mc under ICAS conditions. For more information about these or other Amperex tubes, contact M. Smoler at Amperex, Hichsville, L. I., N. Y.

. . . WA4HWW





The NCL-2000

Val Barnes W1ALU

It can't be that small! A 2000 watt PEP amplifier with power supply just would not fit in that little cabinet! These were some of the initial comments made by on-lookers as I unpacked the white carton that had just arrived by truck from Melrose. I must admit that it did seem a bit improbable.

Pushing aside a pile of QSL cards the NCL-2000 was placed next to the NCX-3, which was used as the exciter. Hmm, same blue cabinet and extruded aluminum, anodized front panel that resists scratching. Installation took only a couple of minutes, consisting of connecting a piece of coax for the exciter output, a short length of zip cord for the relay interconnection, an antenna, and plugging in the power cord

Setting the Band Switch to 20 meters, I pushed the primary power switch and waited for the ready lamp to light, indicating that the tubes were warmed up enough to apply plate power These boys at National think of everything. After about a 60 second delay the ready lamp blinked on and plate power was applied. A quick adjustment of the PA TUNE and LOAD controls and I was ready to call F7GA in Paris to maintain our usual Friday schedule. Hmm, 40 db over S9 in France, well guess I don't have to worry about signal strength. Frank made a tape recording of my transmission and played it back to prove it.

The NCL-2000 covers the 80 through 10 meter bands with a 1000 watt average, 2000 watt PEP power input. The amplifier was not used on 15 or 10 however, as the exciter available did not cover these bands. Two 8122 miniature ceramic tetrodes are used in parallel, which provide 800 watts of available plate dissipation, thus allowing the amplifier to be operated at full legal input without straining anything. It will operate at 1000 watts steady carrier input for AM, CW, FM and RTTY service.

The NCL-2000 uses a passive untuned grid circuit, which allows the amplifier to be driven to full output by an exciter providing between 20 and 200 watts output. This means no fooling around with those attenuators to reduce the output of the exciter to a desired level. Also in the grid circuit is a 100 watt non-inductive resistor which may be used as a dummy load when tuning the exciter. The relative output can be read on the amplifier's multimeter.

The amplifier has the necessary built-in relay and coax jacks for using it with transceivers, or separate transmitter-receiver combinations, making any other controlled relays unnecessary.

A jack is provided so you can connect the amplifier ALC circuitry to your exciter if it has an ALC input.

In addition to primary fusing, a plate overload relay is included to preserve the tubes. The safety interlocks, of which there are two, idiot-proof the amplifier and make it virtually imposible to receive an unpleasant jolt of high-voltage. A lid interlock breaks power to the plate relay and a spring-actuated mechanical shorting bar discharges residual plate voltage to ground when the lid is raised. The shorting bar also gives protection against the possibility of plate interlock failure or an open bleeder resistor.

The amplifier may be used with either a 230-volt, 3-wire or 115-volt, 2-wire power main. The NCL-2000 may draw in excess of 10 amperes from a 230-volt line or in excess of 20 amperes from a 115-volt line under peak power input conditions. The 115-volt service in our shack is already well loaded and since 230 volts provides superior regulation to a normal 115-volt circuit, I used it for our test.

With an NCX-3 as an exciter and a 3-element Cushcraft 20 meter beam on a 70 foot tower, the amplifier was given a good workout for a period of about a month. Numerous quality checks were made on the air with both state-side and DX stations, with only favorable comments being received. A number of questions about the amplifier and its operation were answered over the air.

The station log shows that I was more active than usual during the time the NCL-2000 was available for test, with the addition of about a dozen new countries to my check-list.

Only after numerous threats of bodily harm from Wayne, did I finally pack the NCL-2000 in its white carton and call the Railway Express truck to take it back to Melrose.

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7*	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	21	21	21	21*	21
AUSTRALIA	14	7	7	7	7	7	7	14	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21*	21
ENGLAND	7	7	7	3*	7	7*	14	14	14	14	14	7
HAWAII	14	14	7	7	7	7	7	7	14	14	14	14
INDIA	7	7	7	3*	7	7	14	14	7	7	7	7
JAPAN	14	7	7	3*	3*	7	7	7	7	7	7	14
MEXICO	14	7	7	7	7	7	7	14	14	14	14	21
PHILIPPINES	14	7	7	7	3*	7	7	7	7	7	7	14
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14*	14
SOUTH AFRICA	7	7	7	7	7	14	14	21	21	21	21	14
U. S. S. R.	3*	3*	3*	3*	7	7	14	14	14	7	7	7
WEST COAST	14	14	7	7	7	7	7	14	14	14	14*	14

Good: 9-21, 27-28
Foir: 1-2, 6-8, 25-26, 29-31
Poor: 3-5, 22-24
Es: 13-22 occasional
(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	14	7	7	7	7	7	14	21	21	21	21	21*
AUSTRALIA	21	14	7	7	7	7	7	14	14	7*	21	21*
CANAL ZONE	14	7	7	7	7	7	14	21	21	21	21*	21
ENGLAND	7	3*	3*	3*	3*	7	7	14	14	14	14	7
HAWAII	14	14	7	7	7	7	7	7	14	14	14*	21
INDIA	7	7	7	7	7	3*	7	14	7*	7	7	7
JAPAN	14	14	7	7	3*	3*	7	7	7	7	14	14
MEXICO	14	7	3*	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	7	7	7	3*	7	7	7*	7	7	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	21	21
SOUTH AFRICA	14	7	7	7	7	7	14	14	14	14	14*	14
U. S. S. R.	7	3*	3*	3*	3*	7	7	14	14	7	7	7

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	14	7	7	7	7	7	14	14	14	14
ARGENTINA	21	7	7	7	7	7	7	14	21	21	21	21*
AUSTRALIA	21*	21	14	7	7	7	7	7	14	7*	21	21*
CANAL ZONE	14	7	7	7	7	7	7	14	14	14*	21	21
ENGLAND	7	7	3*	3*	3*	3*	7	7	14	14	7*	7
HAWAII	21	21	14	7	7	7	7	7	14	14	21	21
INDIA	7*	14	7	7	3*	3*	3*	7	7*	7	7	7
JAPAN	14	14	14	7	7	7	7	7	7	7	14	14
MEXICO	14	7	3*	7	7	7	7	14	14	14	14	14*
PHILIPPINES	14	14	14	7	7	7	7	7	7*	7	7	14
PUERTO RICO	14	7	7	7	7	7	7	14	14	14	14*	14*
SOUTH AFRICA	14	14	7	7	7	3*	7	14	14	14	14	14
U. S. S. R.	7	3*	3*	3*	3*	3*	7	7	14	7*	7*	7
EAST COAST	14	14	7	7	7	7	7	14	14	14	14*	14

* Means next higher frequency may be useful.

73

NOVEMBER 1964
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Amateur Radio

ANNUAL NOVEMBER ISSUE

25 Feature Articles 25

73 Magazine

Wayne Green W2NSD/1
Editor, etcetera

November, 1964

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Cover:
No Cover This Month

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de W2NSD

never say die

Conditional Class to be Virtually Eliminated

The FCC announced recently proposed rule making to drastically change the eligibility for a Conditional Class license. The new rules would permit only amateurs living more than 175 miles from an FCC examination point to qualify . . . and this would include their quarterly and semi-annual examination spots. With the exception of a few remote corners of the country, this blankets things pretty well. About one half of one percent of our population lives in these remote areas, so I expect that our present 20% Conditional Class will start dropping.

The new rules would not effect present holders of Conditional Class licenses or renewals, nor would it affect those unable to travel or those in the military.

° ° °

Now see what all that fuss about the Conditional Class license by ARRL has done? The FCC is proposing that it virtually be abolished. And since they have proposed that all current holders of the license will be able to renew as Conditional Class, I somehow doubt if they will get much opposition to their proposed new rule. I'm awfully sure that the League will back this one up since it will almost eliminate the Conditional license, a move which they have already endorsed, and it gives even more power over amateur radio to the FCC, another move which they have endorsed.

A few years back amateur radio was essentially run by the ARRL. The League consulted its members, gave careful consideration to the difficulties to be surmounted and then proposed legislation to improve our lot. The FCC automatically rubber stamped the rules through and our hobby ran fairly smoothly. Though many attribute the decline of the League with the loss of Maxim, it seemed to me that things came to a head soon after the war when it became apparent that ARRL had lost its perspective and was heavily CW oriented. This culminated in the National Amateur Radio Council, a loss of over 20,000 ARRL members in 1948, and the revamping of the FCC regulations so that amateurs would henceforth represent themselves instead of being represented by the League.

Now, instead of working hard to re-establish the faith of the FCC in the League, we find ARRL petitioning the FCC for "firm guidance and leadership." You can probably imagine the impact upon the Commission of the furor over RM-499 too.

Are we going to continue to turn more and more of ham radio over the federal "guidance and leadership?" Just because we have to obtain a federal license to operate our equipment doesn't mean that we can't decide for ourselves, within international regulatory limits, how we want to go about it. We've turned a lot of the running of ham radio over to the FCC, maybe it is time to stop this trend and be responsible for ourselves.

Let's take a look at the present case, the Conditional Class license. There is a valid need for this type of license. Roughly 20% of the amateurs today are Conditional Class. A great many fellows live far enough away from a regular exam point so that it is a definite hardship to appear before an FCC examiner. Quite a few amateurs would be very hard put to lose the two or three days pay that this trip would entail.

The only valid reason that I can see for changing the rules is that we amateurs have failed to honestly conduct these license exams. Undoubtedly we have in certain cases failed. But the FCC proposal certainly is not the only answer to our failure.

When the Conditional Class license was first instituted there was just a small fraction of the present number of amateurs around the country. Today, with approximately one amateur to every 800 population, even the smallest towns have one or two amateurs and few amateurs are beyond easy driving distance from one or more ham clubs. I would like to see more recognition given to the thousands of ham clubs throughout our country for I feel that they, perhaps even more than the individual operator, are the strength and hope for the future of ham radio. I propose that Conditional

Class licenses be administered by valid ham clubs, with at least three licensed amateurs present during the entire test as witnesses.

Frankly, I'd like to see the same procedure for the administration of Novice and Technician licenses. And if this system works out to be as fool-proof as I think it may be, perhaps we could make an FCC appearance optional even in cities where there is a regular examining point. Self determination of this nature on our part could free many FCC employees for work in other regulatory fields where their help is badly needed . . . we might even get more help in prying some of the commercial intruders out of our ham bands.

Now, you have the choice of turning from this editorial and seeing what articles I've got for you this month, or you can sit back for a moment, snap 73 shut and fire off a letter to the FCC protesting this proposed change. Those of you with duplicating facilities should send the 15 copies. I don't know if I will ever convince you that what is happening is your responsibility . . . but I'm trying.

I hope you will also accept some responsibility about the League and make some effort to have all of us, and the FCC, regain confidence in it. You, as an individual, and your club as a group can do a lot to help us regain face. You won't do it by letting things happen and hoping for the best . . . you've already tried that system and it is a dismal failure. You can help by knowing what is going on, talking about it . . . and setting up a holler when some one or group hurts you. Be loyal to amateur radio first.

If we all accept responsibility for what is going on we can easily prevent the reoccurance or continuance of such dismal things as:

- Censorship in QST by HQ
- Defiance of Directors in interpretation of by-laws by HQ
- Secret submission of RM-499
- Scuttling of WA2USA by HQ
- K2US débacle
- Lack of support of amateurs in legal difficulties
- Lack of a program for perpetuating amateur radio at Geneva
- IARU Region II débacle
- Feud with W2BIB
- Withholding of important information on Building Fund
- Commercial favoritism
- Illegal operation of W1AW
- Fascinating "retirement" pay for Budlong
- Incredible salaries (secret) of top HQ staffers

(List continues on page 87)

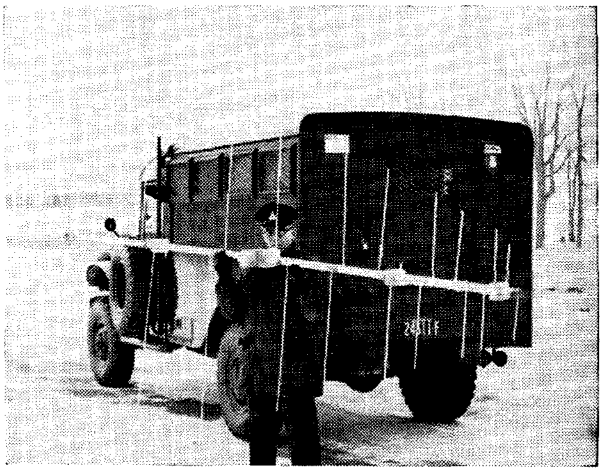
A Wide-Band, High-Gain Antenna

A. E. Blick VE3AHU
Box 37
Collins Bay, Ont., Canada

The goal of every Amateur so far as an antenna is concerned is to have one that will give a respectable gain; is relatively small in size; can be fed directly by a standard feed-line; is easily constructed without recourse to off-beat materials or parts; is cheap; and will give the same performance, especially input impedance and radiation pattern, over a wide band of frequencies.

Such an antenna is the Log-Periodic, the principles and initial design of which were first investigated by Dr. DuHamel in 1956. Other experimenters followed and one of the designs evolved was the Log-Periodic Dipole. A study of the different types brings the conclusion that his is the most practical design for amateur consideration. Basically, the antenna consists of a number of parallel, linear dipoles arranged side-by-side in a plane. The lengths of the elements, the spacing between them and the dimensions of the boom are all determined from a series of mathematical formulas. Full details on the theory and design can be found in Dr. Carrell's report, *Analysis and Design of the Log-Periodic Dipole Antenna*, and anyone wishing to adapt this design to his own needs should obtain a copy.

The finished antenna



This article will deal with a Log-Periodic Dipole that covers the frequency range of 140-150 mc, having a gain of 10 db over a reference half-wave dipole, and directly fed with 72 ohm coax cable. Over the range, the swr is less than 1.5:1, the E-plane beamwidth is approximately 47° and the H-plane beamwidth 85°. The booms are made from ¾ inch, the elements from ¼ inch aluminum tubing (recommended type 65ST6) and each element is fastened to its boom with a 3 inch TV standoff pipe clamp. There are six dipole elements and Fig. 1 a-d shows the plan of each section and how they are combined into one array. Table I gives the lengths of each element and their spacing from the feed-

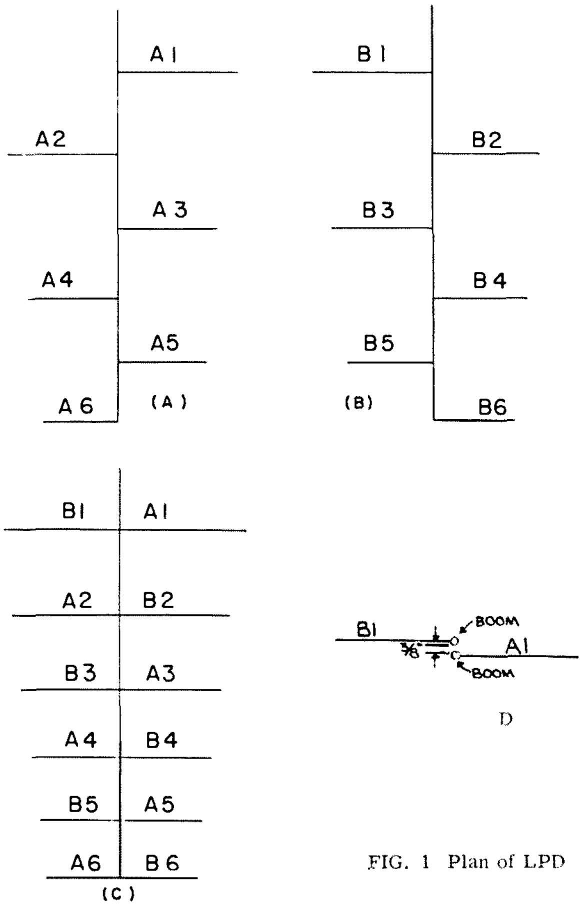


FIG. 1 Plan of LPD

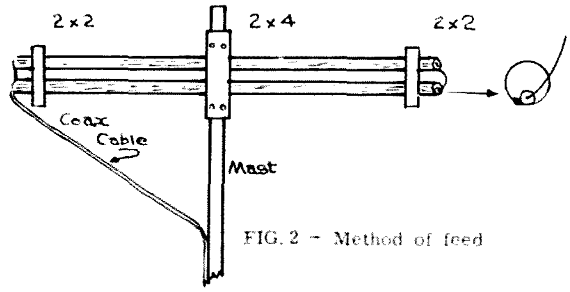


FIG. 2 — Method of feed

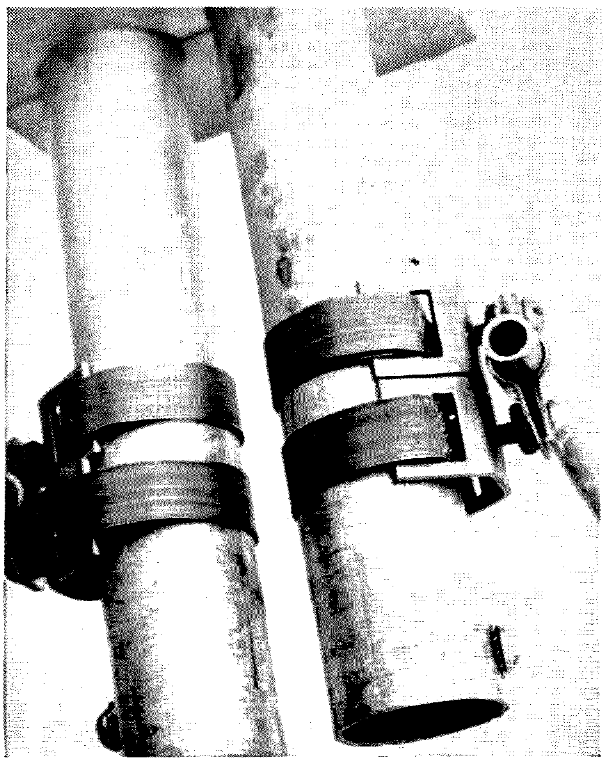
point which is the end with the No. 6 element.

Table I—Dimensions of LPD array

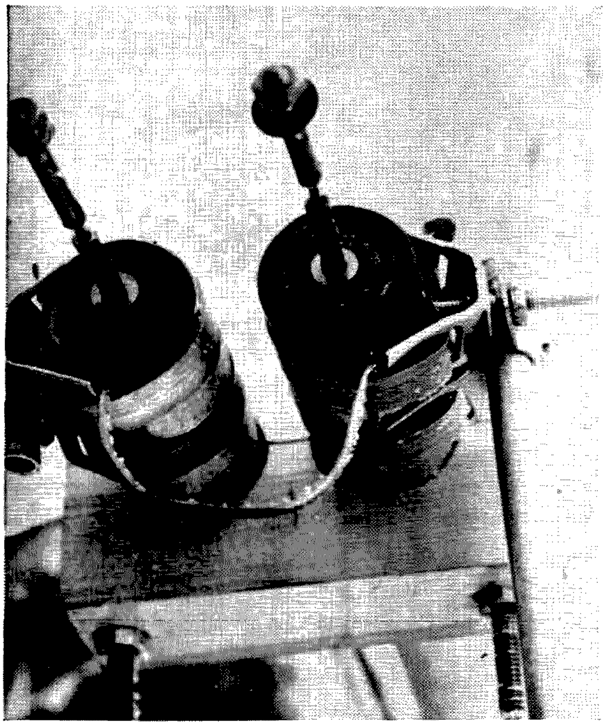
	Length of Element	Spacing from Feed-point
A1 = B1	20.8 in.	60.3 in.
A2 = B2	19.0	46.0
A3 = B3	17.4	33.0
A4 = B4	16.0	21.0
A5 = B5	14.6	10.0
A6 = B6	13.3	0

The boom length is 72 inches so that the boom will project past the last element 11.7 inches. The two booms are shorted together at this point (see Fig. 2).

The antenna is fed with 72 ohm coax cable at the feed-point, with the center conductor attached to one boom and the outer sheath to the other boom. It is recommended that the coax be inserted in the lower boom as shown in Fig. 4 but it can be taped under the lower boom with only a slight decrease in performance.



Our first attempts at securing the elements to the booms were very satisfactory but more costly than the method outlined in the article



Feed point of the antenna and view of the first element and separator block.

The two booms are separated by a distance of ⅝ inches throughout their length. This is done by making two separators and one mounting block. Wood, preferably hardwood, can be used for this. Two pieces of 2 x 2 lumber, 3½ inches long and one piece of 2 x 4 lumber 6 inches long, are required. Two ¾ inch holes are drilled centrally in each block, spaced 1 ⅛ inches center-to-center in the 2 inch face. Two additional ¼ inch holes are made in the blocks so they can be clamped together when sawed apart, as shown in Fig. 3. The boom is clamped by the three blocks, and holes are drilled in the center 2 x 4 block to accommodate two TV mast U-clamps on the 4 inch face. All the wooden parts are then coated with 2 to 3 coats of exterior varnish.

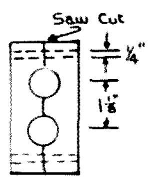


FIG. 3 Separator block

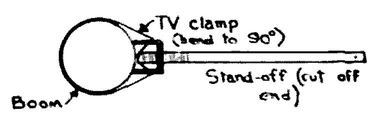


FIG. 4 Attaching Stand-off

The elements are held onto the boom as shown in Fig. 4. The 3 inch TV stand-off is threaded to the pipe clamp on the boom. The end is cut off and the ¼ inch element is put on over the stand-off extension. If 0.035 inch wall tubing is used, you can now thread the tubing over the ½ inch or so of thread that projects past the clamp. If thinner wall is

used, crimp the ends slightly so the thread will bite and if wall is too thick, drill to the proper diameter.

Antennas built as described have been built in this area and have not yet failed to live up to calculated performance. The mechanical construction has been successfully used down to 50 mc and the antennas have withstood severe icing conditions and gale force winds. But experience has shown that a different method of clamping tubing to the booms is necessary below this frequency. One approach might be to drill the boom and insert the element through the boom with some suitable method of clamping, but no research has been done as yet in this direction. I have calculated the dimensions of a tri-band beam for operation in the 20, 15, and 10 meter bands, fed with 72 ohm coax, to give a gain of 7 db on all frequencies within the bands with a swr less than 1.5:1. This would be constructed using 1½ inch tubing for the booms—each 20 feet long—and ¾ and ½ inch tubing for the elements with longest dipole element 33.5 feet long.

The Log-Periodic principle, in practice, will give an antenna that is frequency independent over large bandwidths with frequency ratios of 10:1 being easily obtained. One antenna constructed and in use has a gain of 8 db over a frequency range of 50 to 250 mc, a boom length of 10 feet, and is fed with 300 ohm twinlead with an swr of less than 1.5:1. This has been used for amateur operation on the 6, 2, and 1 ¼ meter bands, and for TV (all VHF channels) and FM broadcast reception. Unfortunately it worked too well and is now used as the family's TV antenna!

I wish to thank Dr. Carrell of Collins Radio for his assistance and permission to use certain parts of his reports and the gang in Kingston who rendered invaluable assistance in trying out these designs.

. . . VE3AHU

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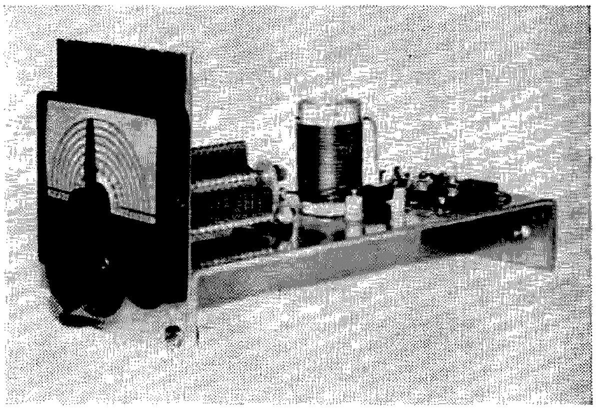
A Stable VFO for SSB

One of the main problems in building SSB equipment is the need for a really stable vfo. Most commercial units are mechanical nightmares which have various types of temperature compensation. Adequately compensating these type vfo's is often beyond the means of the average ham and his limited test equipment. Even so, these best commercial units only say that eventually they will settle down to a 100 cycle drift per some time or other. The three main causes of drift or frequency change in the usual order of difficulty are: 1. Heat, 2. Mechanical Stability, 3. Voltage variations. Therefore, to have a stable vfo simply eliminate these three items. It really isn't that hard.

Let's take the heat problem first. Instead of isolating the tuned circuit from any heat producing sources, we isolate the whole circuit from any heat source. That is, put the



whole thing on a separate chassis. Next, we use transistors at very low power levels. Finally we mount the transistors in and the components on a ⅛ inch thick aluminum chassis. The thirty milliwatts of input power is dissipated into about 2 pounds of aluminum. Thus room temperature prevails.

The "wobbliest" part in any variable capacitor vfo is, of course, the variable capacitor. Using a ruggedized capacitor with small, thick plates and double end bearings is essential. The capacitor must be firmly mounted, thus the ⅛ inch thick chassis again. The coil and *other* components must be rigid also.

Finally, since very little power is used and that at a low voltage, batteries are ideal as a stable power source. There, see how easy it is? So let's build one.

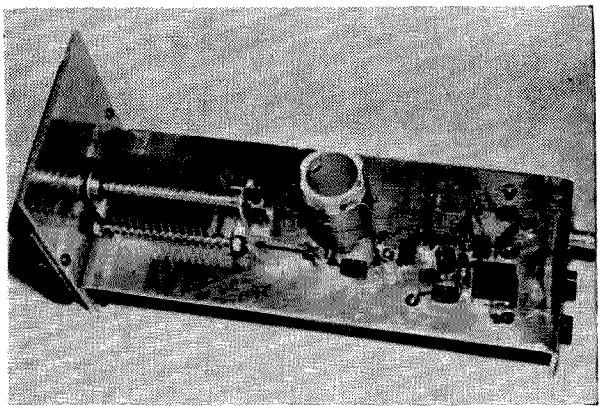
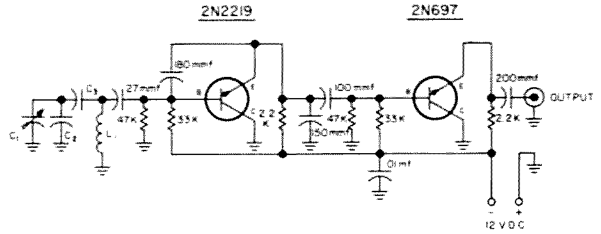


Fig. 1 shows the schematic. Similar circuits have been published before. There are several innovations however. Silicon transistors are used because they tend to change characteristics much less than germanium units with temperature changes. Since the input capacitance of the 2N2219 is only 20 pfd, much less capacitive swamping is needed. In larger capacitors, the actual capacitance change per degree of temperature change can be larger than that of the transistor. Since the 2N2219 is a high gain, high frequency transistor, it can be very loosely coupled to the tuned circuit and still function well. A much less expensive 2N697 or other transistors could probably be used by increasing the coupling somewhat. All fixed capacitors are silver mica units for best stability. The variable capacitor is a Johnson Type R ruggedized unit with wide (.071) spacing. The actual value isn't too important since C_2 and C_3 are used to set the value of capacitance across L_1. The series-parallel combination of C_2 and C_3 reduce the range of C_1 to the value needed, and more important, make any changes in C_1 due to heat or vibration much less noticeable. L_1 is a coil from an ARC/5 unit. Be sure to clean out carefully all extraneous windings

and make sure no turns are shorted.

The vfo is constructed on chassis which is bent from a single piece of ⅛ inch thick aluminum. This is the basis of the exceptional mechanical rigidity. A second piece of ⅛ inch aluminum forms the front panel and holds the Millen 10039 dial. These must be fastened rigidly together. Fig. 2 is an oblique view of the unit. The variable capacitor is not only bolted to the chassis by the mounting feet, but spacers (the black spot under the right rear end of the ceramic support) are



C1 Johnson Type R, ruggedized variable .071 spacing 3" long.
C2 82 mmfd
C3 200 mmfd
L1 21½ turns of #16 wire on 1¼" dia. ceramic form.

glued in under the ends of the ceramic supports to take up any torque forces. A large whole was cut in the chassis and the ceramic coil also glued in place. The front planel extends above the dial so that the case for the unit does not get too close to the "hot" end of the coil and thus lower the Q. All components are wired to ceramic insulators or standoffs. All components are also glued to the chassis for maximum rigidity. The transistors are mounted upside down in press fit holes in the chassis and also glued in place. This "glue" is Ross epoxy weld which is available in most dime stores. Most two tube epoxy glues will work well. Fig. 3 shows a top view of the unit. The bottom two terminals on the rear are for voltage input and the BNC jack is the rf output. These are connected to the top of the chassis by two ceramic feedthroughs.

The output of the unit is about 6 volts peak to peak of nice clean sine wave. If the output is not good looking, juggle the values of the 180 and 150 pf swamping capacitors. This particular unit covers from 4.95 to 5.6 mc for use with a 9 mc crystal filter. When in its case (a box built of ⅛ inch aluminum naturally) and when the unit has reached room temperature (don't cart it in from outside when its 10° below) the total change in frequency around the nominal value should be less than 25 cycles, with reasonably constant room temperature. Don't try to prove it by your receiver; it took a Hewlett-Packard 5243L frequency counter to prove the VFO even changed. There is a little more drift right at turn-on but nothing like those tube (UGH!) units. Since the whole thing only draws 4 milliamps, there is no reason why it can't be left on continuously. Size D cells or lantern batteries will last practically for their shelf life. This way, when you come back next week, you will be precisely where you were when you left. This is a fairly simple project which will give your crystal hetrodyne oscillators reason to blush.

. . . K9ALD

Ken Cole W7IDF
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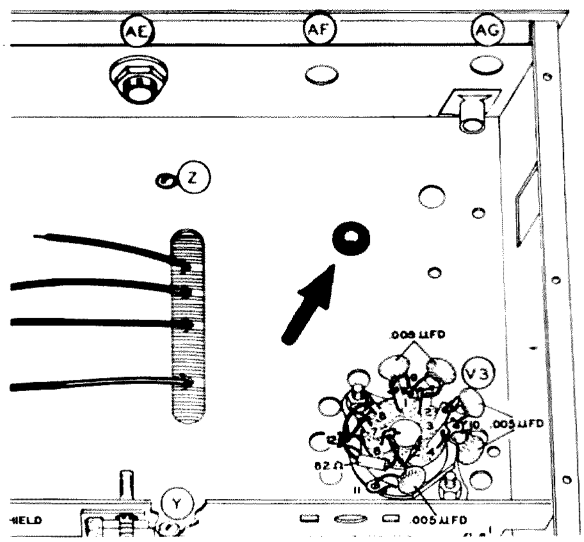
Vashon, Wash.

Color the Gromment Gone

A man in his forties should know what he wants to be when he grows up and I wanted to be a writer but when my writer kit came I checked off the parts list like it said and there was no punctuation included so I only learned how to spel but it was a good kit and we had hours of family fun working on it sitting around the fireplace one of those Swedish funnels and we looked just like the happy folks on the cover of the kit catalog but finally it was finished and I didn't know what to do next because no editor would buy stories that began quote darling exclamation point unquote editors are already overtaxed with their own personal problems which are



often terrible and you will never read about these in their magazines either well if you just sit around smiling at your family eventually it bugs everybody and they look at you like you had an icepick up your sleeve and plans to use it period

Frustrated in my effort to project creatively like folksingers and little theater people I took my doctor's advice and became a ham because punctuation is no problem on phone and the CW nuts only use it to show off until somebody says to them ge you must have a commercial ticket OM and they kick the Variac to weak and come back with QSB om vy sri unable copy last xmission hamming has other advantages too now I can go down in the basement put on the headphones and relax sometimes I even turn on the receiver by the way this doctor is a very active ham on the air all the time since he got mad and gave up his practice because a lady had a baby when he was trying to work FO8AA it turned out the lady was his wife now he works sideband exclusively spreading good will all over the world and he says he really gave up practicing when he switched from AM to SSB but that is a joke for generals and better and if we bring up the subject of licenses Extra Class is unavoidable although I think they are a bunch of soreheads if you try to explain to them the consolation they should find in the idea of personal achievement and never mind any added privileges they always say what is the point they know how dumb they are without a certificate to prove it personally I think the real significance of that fancy license is that it means you are in a minority and if the Birch Society knew about you they would hate you and make you feel good after all this would be an extra privilege and worth the trouble incidentally Green says that just after the second World War there were only fifty thousand or so hams and now there are about a quarter of a million he probably guessed at the first figure but there are enough of us now that we can accommodate some very large minorities in fact we do and I think this gives our hobby a lot of class it also gives us grounds for yelling murder we should have five times the bandwidth we were deemed entitled to in 1946 and if we want to startle Geneva with a demonstration of selfless magnanimity I suggest we concede the frequency economy possible with single sideband and settle for two and one half times what we had in forty six and further that the restoration of equity be effected by proportional expansion thwartships of our present bands which in the lower part of the spectrum are notoriously polluted by broadcast operations of doubtful quality and dubious value accompanied by power mad

jammers usually off their mark because of an itchy curiosity about the programs they are supposed to be jamming incidentally these counterpropaganda megawatters should take lessons from our heavy weight DX sharpshooters on twenty and find out what merciless efficiency means in this connection for some reason California comes to mind and that reminds me a friend claimed W7's think of W6's as an army standing between them and every kind of DX certificate W6's have been known to refer to the middle ground W9's and WØ's as the backbone of the nation a euphemism I believe W8's the descendants of north woods loggers Henry Ford recruited to test drive the Model T nine out of ten W7's work for Boeing and the tenth is the Nevada ham you need for WAS W4's and W5's are the only foreigners operating under reciprocal licensing privileges in our country W1's W2's and W3's are just Easterners generally acceptable as DX to west coast novices anyway the author of this flip filing system was a CW speed demon who sad to say picked up his own echo during an auroral spasm and bugged himself to death but I had a lot of respect for him since the time his neighbor handed him a portable TV and said I hear you like to play with radios you can fix this for me and my friend who had fought the sawteeth of this junk box back and forth across eighty for what seemed most of his life just let it drop on the pavement and after the implosion died away said OOPS and smiled I bet he is still smiling those were the good old days before he dropped CW and went the phase and filter route started using gold color solder from Los Angeles and worked only the upper sideband no matter what because he thought it was swankier until somebody told him the advantage was only semantic and he thought they meant he was just a switch flipper too dumb to understand SSB theory so his feelings were hurt and he went back to breaking speed records on eighty and that was the end which reminds me about this DX60 I put it on the bench to replace an intermittent meter switch afterwards plugging in a dummy load so I could check out my absent minded wiring which turned out ok after the meter leads were reversed but I guess there was a bad connection to the dummy load because when an attempt was made to dip the final there was one of those spitting sounds you hate to hear especially when it is accompanied by a little smoke which it was aha an arc I thought and managed to catch the dummy load connection before doing something else wrong but after that the final just would not dip although the voltages and drive were ok and testing the tank with a dip meter indicated resonance although a little sluggishly I thought aha again the mica blocking condenser has opened but replacing it made no difference then when another ham was helping me eyeball the underside of the final h esaid look at the little burned spot on that grommet never mind his call he is a smart aleck I would have seen it myself in another second if he had kept his mouth shut anyway looking at the grommet I wondered what Heath was thinking of when they said put one in there and what was I thinking of when I put it in after all what good is a piece of rubber in a hole with a conductor carrying the 6146 rf output besides there is plenty of room and air is a good cheap insulator so I cut the grommet loose and measured the resistance through the burned spot it was seven hundred ohms no wonder the 6146 acted funny but now everything was fine it was just like solving a Cape Canaveral malfunction except this one was my fault and I didn't have to send a ship to fish it out of the acean although admittedly for a few minutes there I was thinking of ocean depths in terms of a certain transmitter period

. . . W7IDF

1
I'LL BET THIS POWER SUPPLY I INVENTED WILL...
2
3
4
5
6
HORACE! WHAT DO YOU THINK YOU ARE DOING?
7
8
B. ROGERS

A Tuneable Antenna For 432 MC.

Bill Hoisington K1CLL
83 Bellevue Ave.
Melrose, Mass.

A novel and interesting tunable type of UHF antenna has been developed here for indoor test use, antenna range work, and amateur phased array use, on 432 mc's.

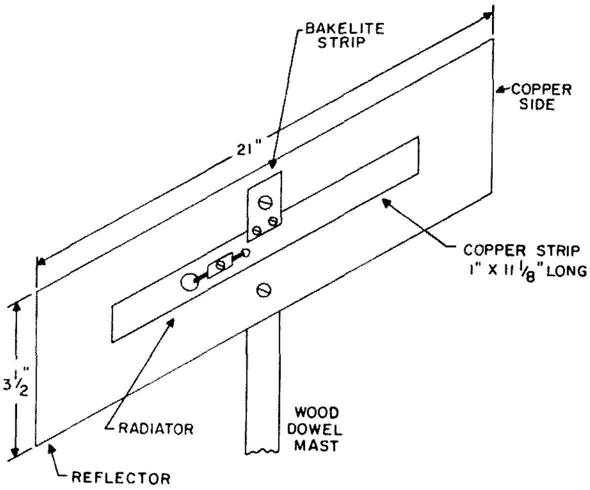


Fig. 1. Front view; 432 mc Test Antenna.

Figs. 1, 2, and 3, show views of the single unit. It is particularly suitable for use with a large screen reflector where many would be used, spaced a certain distance apart in proper phase; with each fed by a separate 50 ohm matched cable. Note that this is a tunable antenna with a knob and plenty of gain and front-to-back ratio, also. A one-to-one SWR can be obtained by juggling the spacing of the radiator from the reflector using the threaded rod in the center; adjusting the trimmer in the matching section; the position along the radiator of the trimmer; and the tuning or length of the radiator versus the "penny" tuning of the end capacitor C2.

The tunable feature can be very useful for working different portions of the band, such as on 440 for ATV. The average antenna cannot cover such a range properly. There are "fancy" new ones that can, but they take some doing as yet. This one can be cut and

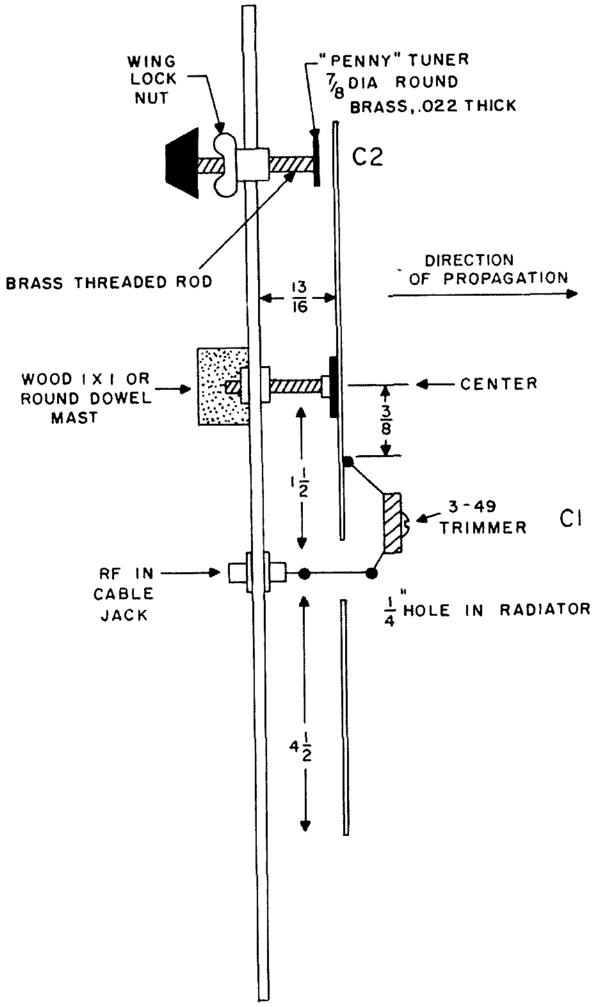


Fig. 2. Top view, 432 mc Test Antenna.

tuned as needed and then retuned with a knob!

Note that the tuning knob and input cable can be tuned from the back of the antenna.

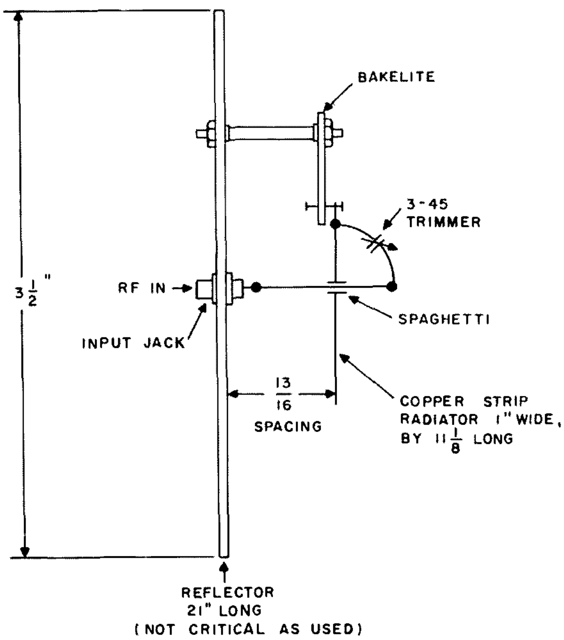


Fig. 3. Side view, 432 mc Test Antenna.

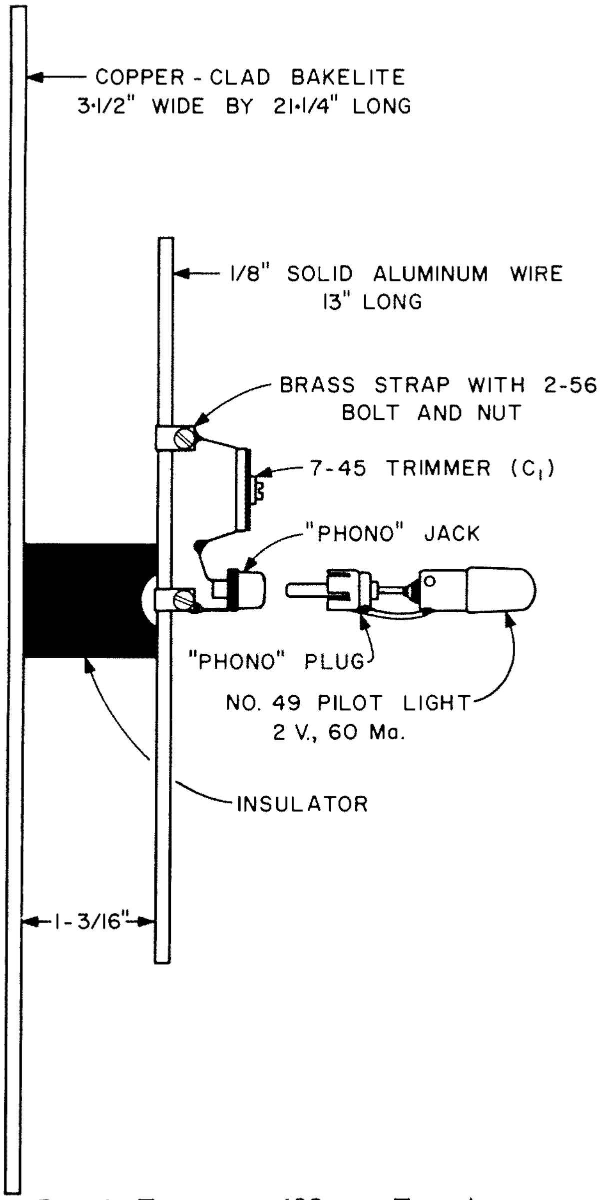


Fig. 4. Top view, 432 mc Test Antenna.

The matching capacitor Cl can also be turned around and tuned from the back through a hole in the reflector with a full-insulator screwdriver. These are useful features and it is quite surprising to see how dead it is in the back. Of course, a larger reflector will have an even greater front-to-back ratio. Note also the resemblance to the famous low frequency "Windham" antenna, with its single-wire feed.

For on the air indoor tests, and small antenna range work, a lamp bulb receiving antenna is shown in Fig. 4. The reflector and radiator assembly are somewhat similar to that of Fig. 1, except that the no. 49, pink bead, 120 milliwatts, is shunted across a section of the radiator which is a piece of solid aluminum wire. Both these antennas can be used on table-top or on floor stands.

... K1CLL

The 432'er

Station Assembly and On The Air Tests

Bill Hoisington K1CLL
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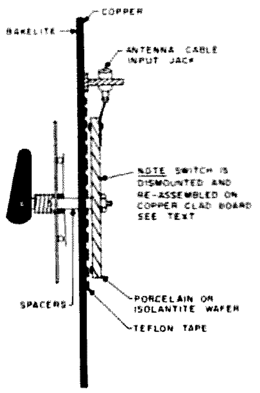
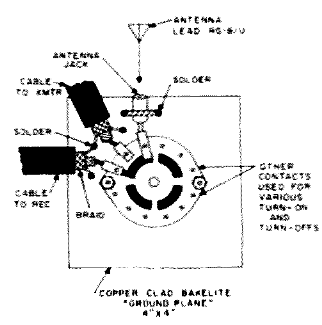
There comes a time when you have to put everything together. That new beam must be mounted and the cable led into the shack, a send-receive switch installed and tested (see below), along with the transmitter turn-on switch, or switches, the receiver mute switch, etc.

First attention must be paid to the send-receiver switch. If a rotary wafer switch will do a good job this will maintain the low-cost philosophy of the 432'er as designed. An ordinary porcelain (Steatite, Isolantite, or what have you, but not bakelite) switch was taken apart and remounted very close up against a copper-clad bakelite "ground-wall." See Figs. 1 and 2. The spacing between the porcelian wafer and the copper is actully less than a 16th of an inch. This wafer is 1 and ⅝ inches in diameter. The switch can be any good make of the material mentioned, but should be of flat construction. That is, viewed from the side as in Fig. 1, the switch contacts should lie as flat as possible to the copper wall. I was able to sue the original bolts with one additional washer added to the fiber washer between the wafer and the copper wall. Fig. 2 shows a face-on view. Prepare each cable end carefully using a minimum of *exposed* center conductor. This includes the center conductor inside the insulator material as well. As soon as it is outside the braid it is "exposed." I find that separating the outer conductor, or braid, into two pigtails and soldering those flat to the copper wall works FB. Note that if you use solid copper you may have to use too much heat and melt some of the cable insulation. Of course, if you have Teflon insulated cable, FB for you. I used ordinary RG-58/U, and *care*.

This should cover reworking the wafer switch. Now for the results. An exact duplication of on-the-air conditions was set up in the shack. A two-element beam was fed with matched RG-58/U cable from the transmitter *first* without going thru the switch. A second beam across the room lit up a test bulb with rf, checked with power detector and meter. Then the switch was inserted in the line between the transmitter and the test antenna. Actually the bulb lit *brighter* after





the rf had gone through the switch! This was, of course, due to a slight mismatch and the cable length change that occurred. After matching everything again I could detect no difference in rf in the second beam between switch and no switch. So that works. I also checked later with small signals on reception. Still no detectable difference.

Notice that the flat-line construction makes for a sort of "strip-line" configuration which is quite "legal," well up into microwaves.

Power Supplies

I actually used three power supplies. 325 volts (needed more) on the modulator, 400 volts on the three 2C39's, and 150 to 250 volts on the crystal oscillator and first doubler.

As soon as I get a VR tube on the 6CL6 oscillator I may reduce the number of power supplies to two. See also "On The Air Tests" below about oscillator stability on 432. The ac center taps on the power transformers are brought out on well insulated cables to disable the HV on "Transmit." Also on "Transmit" the receiver voice coil is opened. So far this

"compact" is pretty well spread out but it *will* go together eventually for mountain-topping. Don't forget to connect the two gounds, that is the modulator chassis and the rf base plates.

That's about it for station assembly except for some details taken up in the "On The Air" section, and one more item that is hard to do without. You've got to know, while tuning, making bias adjustments, turning voltages up and down, testing tubes for *frequency* operation, etc., whether more or less rf is going into the antenna cable. This item is simply to allow you to see whether such adjustments make an rf increase or not, in the power into the cable. Like the power meter on the rf output of a Gonset. This must be done *on* the cable and must *not* pick up rf from the rest of the rig anywhere. I settled it, at least for the shack operation, by coupling a 432 mc power detector (see 73 Mag.) into the antenna cable which is RG-8/U, about 10 feet along towards the beam where there happens to be a connection with about ¼ inch open to the breeze. (Not desirable.) Three quarters of an inch of the end of a 5 foot piece of RG-58/U cable was stripped of the outer braid and looped through the connector, but not touching the center conductor of the antenna cable, which is carrying some 5 to 10 watts of rf. About ⅛ inch away. Plenty of 432 rf registered on the detector output meter. Of coure, if you have an antenna bridge good for 432, and also if you want to keep it for the 432 rig in your shack, that's OK also. I'm thinking about checking into what makes a good one for 432 and 1296 for amateurs. If possible.

The gimmick described above does show the sum total of everything you do to the rf, even like forgetting to throw the antenna switch!

The 432'er on the Air

The great day. For me. For you, when you come to it. Nervous as a cat all day. Changing modulation transformers in mid-stream didn't help either. Like building a test dreamcar and then finding the drive shaft is open in the middle of somewhere.

In 1946, yours truly wrote an article in QST, "Getting Started On 420." (And they say History never repeats!) So now, 18 years later I get on the air once more on 432. It's my own fault of course, that I missed those years. The ranks of the 432 faithful have been growing making me now a real newcomer. I got a nice welcome though, I must say. If you want a real friendly band just try 432 (Even more so, try 1296!) They soak up new stations like a dry sponge. I hope my efforts with strong asssitance from W2NSD for a good low cost 432'er, will help the situation.

So away I went, modulator on the left, rf section in the middle with the antenna switch, then receiver rf amplifier, mixer, Lo. chain, and Morrow receiver on the right, buzzing away merrily on 28 megacycles.

Couldn't wait for 8 PM Wednesday, the magic hour for 432 in this section of the U.S.A. Went on at 7 PM. An immediate answer from W1BU. He has a "band scanner" running, with receiver lock-on. Very FB. This of course is good old Frank, W1EHF, perhaps *the* most faithful of the 432 fanatics in New England. I can't tell for sure yet but later on after a few mobile visits I might judge better. A few modulator checks on the 432'er and we carried on for a good hour. First thing, frequency stability, with shift and drift. Cured almost 100% of it by cutting down on the crystal oscillator plate voltage. Should have remembered! 40 to 50 mc crystals do *not* like more than 100 volts. Frank is trying transistor oscillators in thermos bottles! Darn good idea too. More later on that. My *receiver* also jumps around in frequency when the XYL turns her Tee Vee on or off, dishwasher starts, etc. I find this is par for the course on 432. Frank even has an ac voltage regulator down there in the Reddydendron Swamp. (300 feet high incidentally.) This just goes on my list of "things-I-didn't-know-about-432-til-now." A couple of dc voltage regulator tubes, will go in here very soon.

Frank says even filament voltage causes some drift. Maybe transistors will be the answer. What about 1296? Wow. At least I will be watching for it.

Let's see what else happened. "Ur signal 62 db above noise in Medfield." 25 miles away, flatland. Sounds good, for only 8 to 10 watts out here. Not pushing anything *yet*.

Frank says the transmission he was making last week was a varactor multiplier putting out about 2 watts. Was S7 over here then. He gave me a FB rundown of the stations on the air, but *that* I hope to report myself, first hand, soon. Nashua, N.H.; Springfield, Mass.; Rhode Island; 2GRI near Saratoga Springs, N.Y.; etc. Wednesday night at 8 PM is the big date at present.

A good CW signal was CQ'ing as soon as W1BU signed off. "CQ de K1JIX" Another old faithful, of course. He used to be W2BVU in Poughkeepsie, N.Y. Knew him when. Swung the beam from SW to West on Harvard, Mass. 30 miles away and JIX boomed in over 9. He also answered on fone pronto. Plenty of good info as well on everything about 432. What did I tell you? The welcome mat is *really* out on 432! Will sure visit his shack soon as I get mobile on 432.

WIOOP, still another real old-timer, was calling next at 8 PM. 20 miles away. Hank had plenty of real dope on receiver front ends; is very partial to crystal mixers for the first stage at present. Well, I've got one here, recently described in 73 Mag. Will check with on-the-air tests. Incidentally, *all* these lads are in the 100 watt and over class! I'll *have* to go mountain topping to compete with *that*. Or maybe four of these 14 element jobs?

Then, to top the evening off, as if it was needed, K1JIX has asked for 9 P.M. with W2GRI who is in N.Y. state, some 145 miles airline from me. JIX is on a 500-600 foot ridge in Harvard, Mass., some 30 miles nearer him. At any rate, I heard GRI's carrier every time he came on, peaking nicely on the beam West-N.W. About 10% of the audio came through.

I certainly hope to QSO 2GRI before many days. Have to be on CW for now though. I have an old rusty key somewhere. Not as rusty as my first I am sure, but I can do it if I must.

That's all for now. All I have to do is to put it all in one box with a handle. Well, maybe two boxes first. We'll see.

When will *you* be on 432?

. . . K1CLL

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Precision Audio Attenuator

It is very desirable to use an attenuator for all types of audio work, whether in the hi-fi field, in checking a modulator, or in investigating a new clipper or limiter. This professional quality attenuator was designed for these purposes and was further designed to use the standard 5% tolerance carbon resistors. Since the resistors were used in pairs in parallel, the 5% is reduced a little so that perhaps 3% tolerances are reached in the overall result.

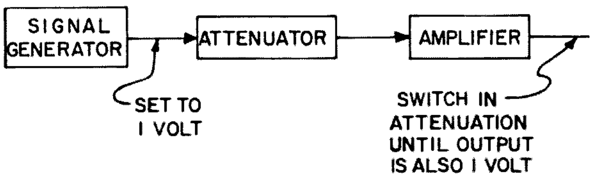


FIG. 1

Since the attenuator has a total of 100 decibels total attenuation, it is necessary to keep the input and output far apart and use an enclosed metal box to prevent feed-thru. A long metal box with the input on one end and the output on the other and all the switches in a straight line between them is recommended for construction. Also, the attenuation sections have been designed in the form of pi-sections so that the resistors can be supported by the switch terminals and a straight length of No. 12 copper wire which passes thru as the ground from the input to the output ends. Protect the resistors from excessive heat with long nose pliers while soldering.

The switches are of the double pole double throw (dpdt) type and alternately switch in a pi-section or a short bypass. The switches will carry very little current and can be of lightweight construction and should be easily operated to keep from moving the entire box, since the whole unit is not very heavy.

The meter and the input resistor will aid in the establishment of an initial level, and db can then be set in as db below, say, 1 volt. The meter can be one of the small VU meters currently available, or the adjustable resistor and meter can be eliminated if a metered output is available from your signal generator. The attenuator must aways be terminated in 600 ohms, but since a proper termination is usually not available, a 600 ohm load is available at the output and can be switched in as desired. The normal high input impedance of amplifiers will not shunt the output enough to disturb the calibration. When feeding the output into a carbon mike input, the input impedance should be adjusted to 600 ohms with aid of a resistor in parallel with the input, or a resistor in series with the carbon mike input. Measure with an ohmmeter to be sure, and then connect the attenuator output.

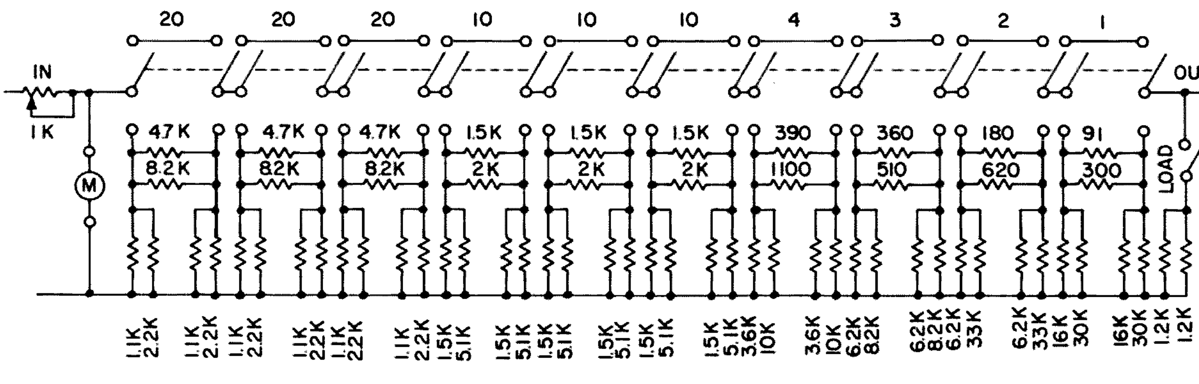
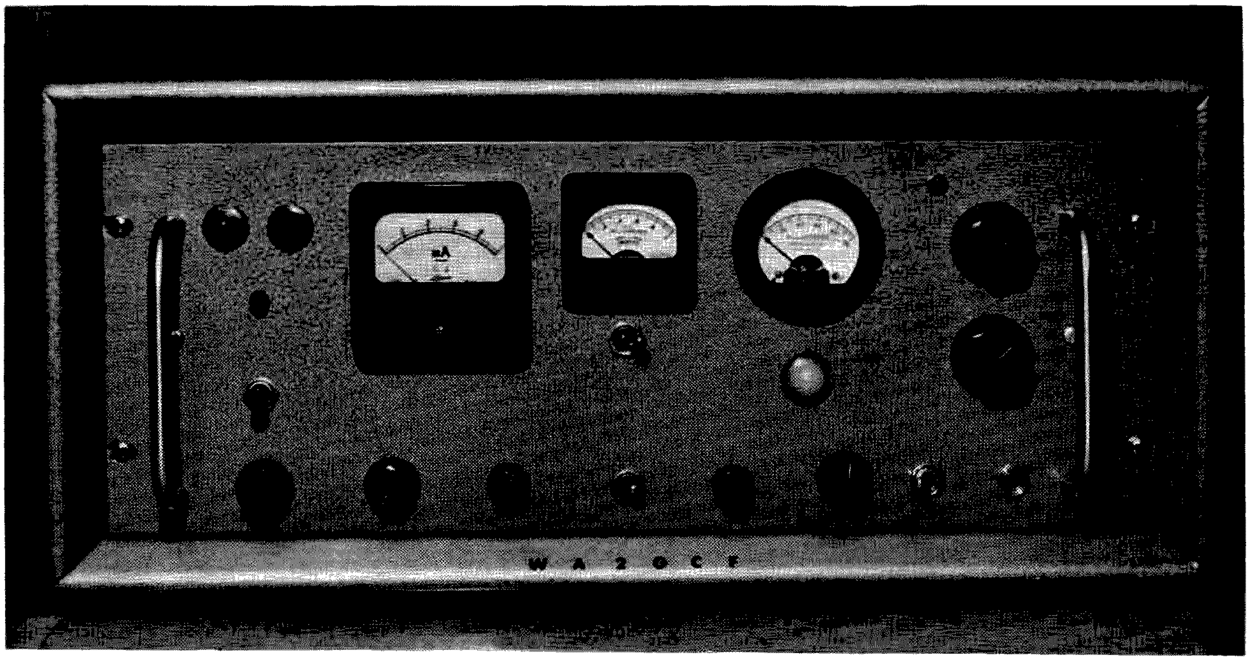


FIG. 2

To measure amplifier gain, for example, the signal generator is applied, and the output adjusted to 1 volt at the desired frequency. Then the output of the amplifier is monitored, and when the output is also 1 volt, the attenuation of the attenuator is the gain of the amplifier. (See Fig. 1) This is the most straightforward way of using the attenuator in making amplifier gain measurements.

. . . K9QYI



SIX METER VFO TRANSMITTER

the HAMTRONICS SPECIAL

Jerry Vogt WA2GCF
160 Grafton Street
Rochester 21, N. Y.

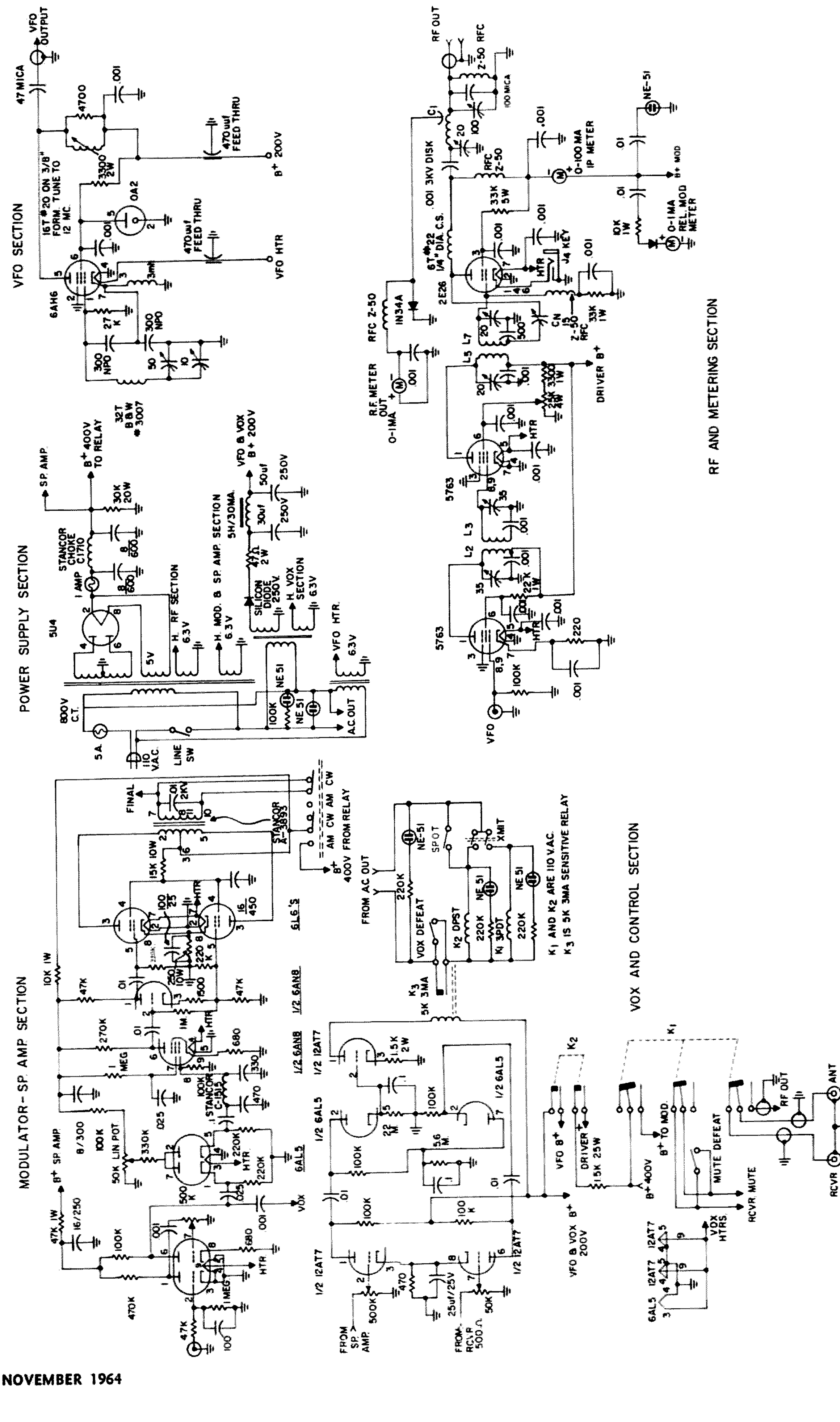
SOME TIME AGO, a prominent editor made a statement that there wasn't enough homebrew equipment being built any more. It was then that I decided that it might be fun to start a small business building special equipment that might not be found on the market due to lack of interest on the part of the amatuer consumer in general. Thus came the name "Hamtronics."

As was suspected, the enjoyment and satisfaction of building this type of equipment is unequalled, especially when it doesn't cost anything for parts since this burden is borne by the customer who wants such equipment. The transmitter-plus, which is described herein, is the result of this idea.

As seen at first glance, we have here a low power six meter transmitter. So, big deal! But, it is a big deal because this is no ordinary six meter rig. It incorporates some frills which just aren't available in the commercially built type of gear. It has extras, such as VOX, speech clipping, flashy lights, single function switch, modulation indicators, output meter, mute defeat, and . . . it is broad banded. It will cover 50 to 50.8 mc without even touching anything but the vfo. It can be built by anyone who has a few tools and appreciates goodies. Convinced? If so, read on. If not, think of that last contest when you had to constantly fiddle with controls to chase that rare multiplier.

Circuit Details

The vfo is a 12.5 mc Clapp circuit employing a 6AH6 oscillator tube. Solid mounting and short leads are the secret of stability for a vfo of this type. The oscillator grid tank coil consists of 32 turns of a B & W Miniductor coil #3007 permanently mounted on a 1" by 3" piece of ¼" thick plexiglass. Polystyrene would work equally well. The coil is temporarily clamped to the block with aligator clips while a good thick coating of Q-dope is poured onto the assembly. After a few hours, the clips may be removed and additional coatings applied. Mount the plastic block using one 8-32 machine screw at each end with a heavy metal spacer approximately ⅜" long on each screw. NPO condensers are used



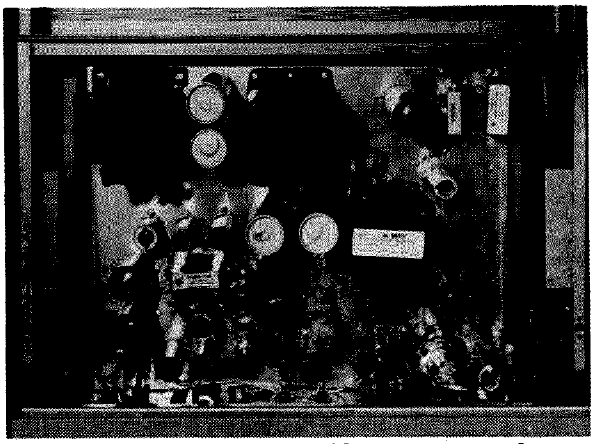
Hamtronics Special Six Meter Transmitter deluxe

in critical places and the screen circuit (which acts as oscillator plate) is voltage regulated for stability. The output plate tank circuit takes the form of a ⅜" slug-tuned form with 16 turns of #20 wire closewound on it. The 4700 ohm resistor helps to broadband the tank circuit so it has uniform output over a wide range. The vfo is built in a 3" x 5" x 2" mini-box. It is not on the chasis with the rest of the rig because of the heating problems encountered when first tested. Now the vfo is mounted seperately on the rack in which the transmitter is housed.

The rf amplifier section employs a 5763 doubler operated with cathode resistor bias for added safety. A short length of RG-U/58 connects the vfo to the phono jack in the first amplifier stage. Plate tank with L_2 is tuned to the low end of the expected frequency range which in this case is 24.9 mc. Then, the next stage grid tank is tuned so that L_3 resonates at the high end of the expected range or about 25.5 mc in this case. The net result of tuning the tank circuits in this manner produces a uniform coupling coefficient throughout the range of frequencies to be used. Similarly, the 5763-multiplier-driver tank is tuned to 49.8 mc at the plate and the 2E26 final grid circuit is tuned to 51 mc. Thus the driver controls, once set, will never have to be touched again.

The final amplifier, with its 2E26, is grid-neutralized for freedom from spurious radiation and linearity of modulation abilities exist. The parasitic choke, mounted on the plate cap, is made with 6 turns of #22 bare wire with ¼" inside diameter and is spaced with one wire diameter between each turn. The total length is about 5/16". rf chokes are common Ohmite Z-50, 7uh. solenoid types. A phone jack in the cathode circuit may be used as shown if cw operation is contemplated. The 33k/5w screen resistor may be made from 3 100k/2w resistors connected in parallel.

The final amplifier output tank circuit consists of a pi-network in which a moderately low Q is employed to good advantage. By using this type of arrangement, effectively, the output circuit is broad-banded, for at least as much as 700-800 kc. This can be a very convenient extra for use during contests since it eliminates two more control-settings that would ordinarily take place when you QSY to catch a rare DX station and still want the final to be tuned efficiently. A .001 mfd/-3kv disk or mica condenser is in series with the tank circuit to prevent dc from being coupled to the antenna. The plate capacitance is almost enough to tune the input of the tank



so only a small, 20 mmfd tuning condenser is used. The tank coil itself, is only 3 turns of B & W #3010 coil stock and the output or loading condenser is a big 100 mmfd shunted by a fixed value of an additional 100 mmfd mica, 1000 volt condenser. The rf choke from antenna to ground provides two functions. First, it smokes in case the dc blocking condenser breaks down so that you know there is high voltage on the antenna line. Second, it provides a means of kicking out the high voltage fuse after the smoke signals appear.

The metering section has three meters with useful functions. On the right hand side of the panel is the 0-100 ma meter used to measure the plate and screen input current to the final amplifier stage. The center meter is a 0-1 ma meter used as an rf voltmeter to measure the relative rf output level. The third of the meters, left, is a larger size meter, 0-1 ma, used to measure the relative modulating level. While the latter is not really necessary, it provides an interesting conversation piece and may be used as a check on the modulation if you should move back from the mike, etc. When first set up, it may be checked against a scope to determine full scale at about 100% modulation. The NE-51 panel lamp also indicates that the modulator isn't loafing. It blinks as you reach modulation peaks.

The modulator and speech amplifier stages line up as follows. A 12AU7, two stage speech amplifier is operated from the power supplied directly from the high voltage output of the supply and is not controlled by the relay, K_1. This allows its use in conjunction with the vox circuit. A 6AL5 operates as an adjustable, symmetrical speech clipper and is followed by a low pass filter scheme in order to reduce harmonic distortion which is generated by the squared wave-form produced by the clipper. A 6AN8 pentode section is used as a high gain driver and the triode section is used as a phase inverter. This feeds into the 6L6, class AB_1 modulator stage, producing a solid 15

watts of audio from the modulation transformer. The latter is a 60 watt Stancor-Poly pedance type. This, while over-rated, allows the audio to reach the final rf stage without showing the ill effects of saturation in the core of the transformer. Another good reason is that it costs only a little more than the smaller version.

The vox and control section employs a rather standard circuit. One half of the first 12AT7 is used as a vox amplifier with its 500k vox level control. The opposite half is an anti-trip amplifier with its associated 50K level control. These amplifiers feed their respective signals into the 6AL5 detector stage which rectifies and phases the signals so they can be used to bias the second 12AT7 relay tube. The vox can be defeated with the defeat switch, which shorts the relay contacts. In either case, the switching action closes one side of the other relay coil circuits and the other side is switched by the proper function switch. The switch on the left hand side of the panel acts as spot switch when thrown to the right, and the spot relay and yellow (left hand) light operate. When thrown to the left, it acts as a transmit switch, turning on both the power relays, K_1 and K_2 and also operates both function lights. The small light in the center of the light-triangle is a power-on indicator which shows the power supply is operating. K_1 switches the high voltage for the modulator and rf final amplifier stages and switches the receiver and antenna circuits. The receiver mute may be disabled by the mute defeat switch, should you like to listen to yourself talk for testing purposes. K_2 applies high voltage to the driver, multiplier and vfo stages.

The power supply section consists of a 5U4 rectifying the output from an 800 volt center-tapped television transformer, seperate 6.3 volt heater windings for modulator heaters and rf heaters and a silicon diode rectifying the output from a 250 volt transformer for the vfo and vox circuits. Since it was available, a 6.3 volt winding on the same transformer was used for the vox section heaters. Still another transformer is used for the vfo heater so that stability would result from leaving the heater on when the rest of the transmitter was turned off. Standard condenser input filter systems were used in each case. Special notice is given to fusing of the main high voltage supply so that if the high voltage output from the 5U4 was shorted out, the 1 amp fuse would go—not the rectifier or the transformer.

The transmitter is built around a 7" rack panel so it may be mounted on a rack as shown in picture 3 or else it may be enclosed

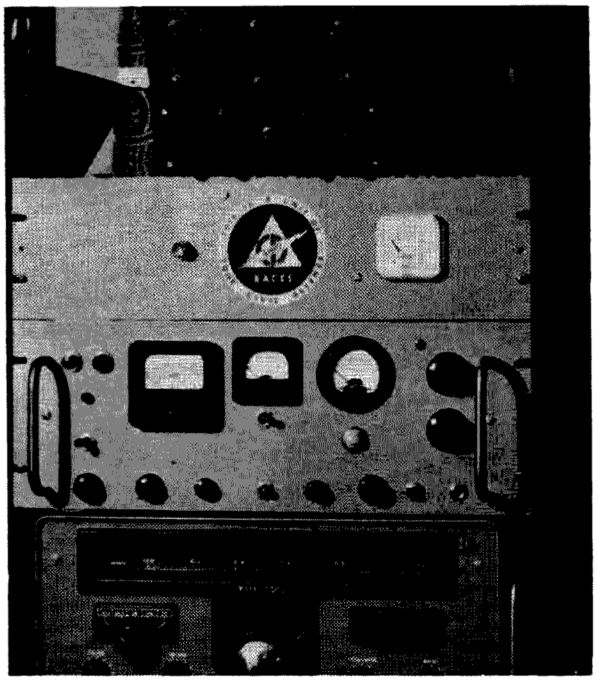
in a suitable cabinet as in picture 1. A 2" x 17" x 14" aluminum chasis is used so that metal working can be accomplished with minimum trouble. As seen in picture 2, the power supplies are in the rear of the chasis and the modulator occupies the left hand side of the front and the rf section occupies the right hand side. Much could be done to improve appearances if, now that the difficulties have been found, we could build another unit. However, that job is up to you. The basic layout can be seen and it is one that is very easy to work with, since all critical circuits have controls mounted within close proximity. This eliminates need for long shafts, shielded cables and compartmental construction.

The neutralizing condenser, seen mounted at the left side of the final tube, is actually supported by a small piece of #10 wire soldered to the plate cap of the 2E26 and the stator lead runs 3" down through a hole in the chasis to the grid tank coil. The final plate tank components are mounted on the panel, the loading control being on the bottom and the tuning condenser is on the top, while the coil is mounted between the two condensers. The fixed mica condenser, which shunts the loading condenser, is soldered to the loading condenser stator and runs to a lug at the chasis with very short leads.

The remainder of the layout isn't critical, however, this plan is recommended since it results in short lead lengths and ease of construction. Good solder connections are important and a little extra care will eliminate headaches later on.

Controls across the bottom of picture 1 are left to right as follows: audio gain, clipping level, mute defeat, am-cw, vox delay, drive level, power off-on and key jack. The switch immediately under center meter is vox defeat and the light under the right hand meter is the modulation indicator. The loading control is the lower of the two at the right and the final tuning control is above it. Handles provide a means of protection for the controls and also dress up the front panel.

Alignment is relatively simple compared with some kit type transmitters. A good way to start is by disconnecting the second 5763 and tuning the tank of the first 5763 plate for maximum rf output at 24.9 mc. Then tune the second condenser so that with 5763 re-connected, maximum response occurs at 25.5 mc. This may be measured with an rf probe and a vtvm or a grid-dip meter. Tune the plate tank of the second 5763 to 49.8 mc and the final amplifier grid tank to peak at 51 mc. The final plate voltage is then applied and both the final tune and loading controls are



set for maximum reading on the rf output meter with a dummy load or antenna connected.

With a scope coupled to the final tank coil or by having someone listen to your signal, you can then set the speech clipping control for 100% negative modulation peaks. Positive modulation peaks will be about 80-90% which is very good for this type of transmitter. Perfectly symetrical modulation is difficult to obtain due to the common power supply setup, however, don't hit the mike too hard when working locals since they aren't used to turning their af gain controls down because the speaker cone hits the other wall! In short, you have good, heavy modulation which must be respected. In my case, I have had people say they could hear neighbors five doors down the street when I keep the window open.

This rig has given me more fun per hour of operation than any commercially produced type has. It will do the same for you. If you are tired of going on the air and chewing the fat all the time like I was, start building gear. No matter how simple a piece of homebrew gear is, *you* built it! That counts. Your editor, Wayne, must be commended on his homebrew campaign. Many people have told me they started taking an interest in construction projects because they saw it in 73. I, myself did, and for this reason I would personally like to thank "Mr. 73".

If and when you build this transmitter, please drop me a note and let me know how you enjoy it. Then the purpose of this article will be completed. If this project makes one more homebrew addict, it will be a success!

. . . WA2GCF

A Sterba Curtain for Two Meters

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Poughkeepsie, N. Y.

Having just acquired a nuvistor converter for two meters, the author cast around for a suitable antenna with which to listen to the local gang. Being in the middle of winter at the time, any outdoor projects were out of the question. Since the house here is a Cape Cod type with an expansion attic, the idea of using an indoor broadside array came to mind. It seems that here in the Hudson River valley, the majority of activity is concentrated in a north and south direction from this QTH. The house is so situated that a broadside array would favor these directions, the bidirectional aspects of the antenna taking care of the two directions.

Therefore the project was begun and actually took about an hour and a half to fabricate the antenna and install it in the attic. As can be seen from Fig. 1 the outside dimensions of the antenna are 10 feet long by 6 feet 8 inches high. The matching stub increases the height by another 20 inches, but the stub can go out parallel to the floor if height is a problem. The antenna is made out of #14 soft drawn copper wire. The insulators were cut to 1¼″ lengths from ⅜″ lucite rods. The phasing sections were made of 450 ohm wire feed line. All connections are well soldered to keep rf resistance as low as possible. Make sure the phasing sections are transposed (twisted) as shown on the drawing. This is necessary in order to get the currents in the dipole sections in the proper phase with each other. The antenna is 9 half waves in phase with a theoretical gain in two directions of 9.5 db. The author uses RG 58/U coax transmission line from the basement to the attic and then into a coaxial balun to drive the antenna through the ¼ wave stub. The proper point to attach the balun to the stub was found by using a transmitter, a Jones micro match SWR bridge, and a pair of alligator clips on the balun so it could be slipped up and down the stub for the lowest SWR reading. The proper point will give close to a unity SWR reading and in the author's case, was 15 inches from the shorted end of the stub.

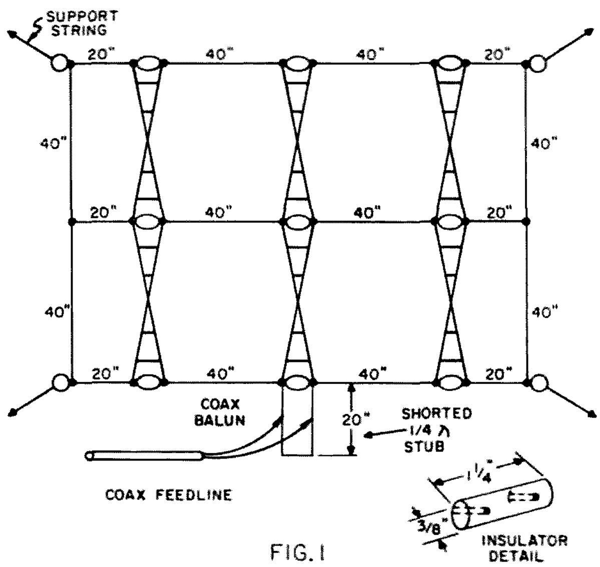


FIG. 1

Performance? Well no article is complete without a description of the results obtained. In this case, stations in Albany, N. Y., 85 north of this QTH and stations in New York City, 85 miles south of here are copied with ease.

The equipment here consists of a nuvistor converter into an HQ-129X and the transmitter is a pair of 6146's running about 100 watts. The antenna . . . a STERBA CURTAIN.

Try this wire array. It doesn't cost much in time or money and its performance may surprise you.

. . . W2ZBS

Eugene Fleming WΦHMK
Box 884
Grand Junction, Colo.

Electrolytic Saver

Photos by Bob Droulard WφCNH

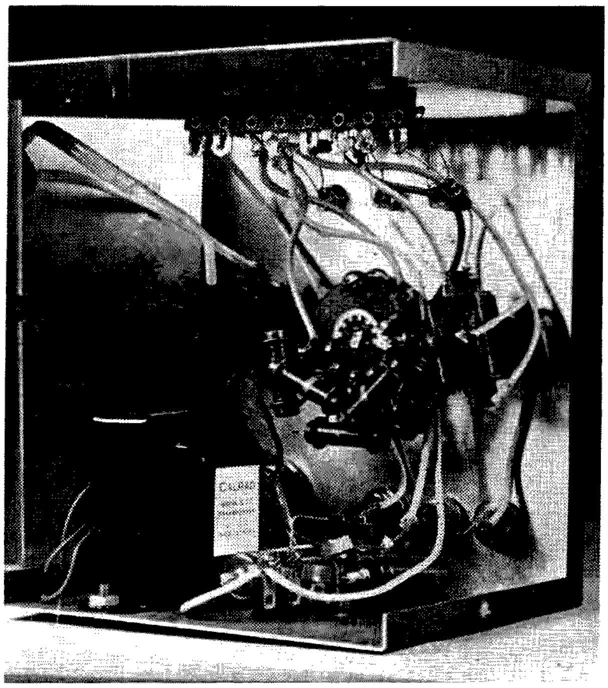
The explosion of an electrolytic capacitor is not only unnerving, it is downright dangerous. True, there are not many capacitor explosions in sacks across the country, but filter capacitors with deformed electrolytes are a major source of smoke during the initial testing of power supplies. The instrument described here can pay for itself by preventing the destruction of only a handful of electrolytics.

After a nerve shattering explosion of a 'lytic salvaged from some unremembered defunct gear, I decided to prevent recurrence of the episode.

First the cause of the smoke and explosions needed to be known. That meant searching through theory books looking for information on a subject seldom mentioned. Such a problem does not occur in industry or repair shops since new units are always used. Here is a summary of available information:

Electrolytic capacitors are made of two plates of metal foil seperated by a thin film of chemicals called electrolyte. Under electrical tension this film is an insulator. However,

when no voltage is applied to the foil plates for many months, as happens when a unit is stored in a junk box or is in unused equipment, the film tends to "deform." This means it is no longer a good insulator. When voltage is applied, current is permitted to pass through the



film. Heat is generated in the resistance. The heat becomes great enough to vaporize some of the electrolyte if the current is high. Pressure builds up, and something's gotta give. A unit which has one end sealed with a rubber-like compound will seldom explode, but will break open and fill the shack with stinking yellow smoke. Capacitors firmly sealed will give more thrilling results.

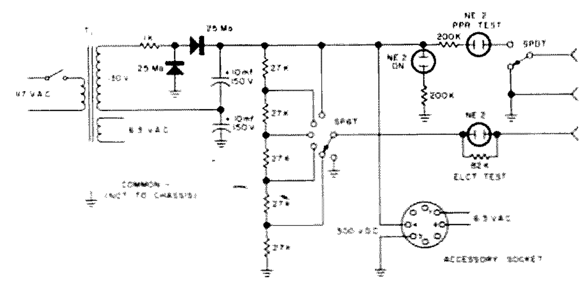
The electrolyte can be "reformed" by applying a gradually increasing voltage and keeping the current below about 1 ma. This voltage can come from a capacitor tester, since most models have variable voltage provisions. The drawback to this approach is that the testers usually have a spring releasing saftey switch that applies the voltage. To rejuvenate a capacitor then means sitting with thumb on switch or laying the tester on its back and weighting the switch with a spare transformer.

Neither of these alternatives is particularly

attractive. I figured that it should be fairly simple to design a gadget that could provide a variable voltage and a current limited to a safe value for reforming the electrolyte.

To start with, we need a voltage source that will provide adequate potential to reform most capacitors in common use. A voltage doubler working directly off the power line would be cheap and simple, but also dangerous, since one side of the line is grounded. This is easily remedied by using an isolation transformer. A full wave voltage doubler gives slightly more than twice the transformer rms output voltage when the drain is light.

A voltage divider of five 22K resistors will draw about 3 ma. At the same time, multiples of 60 volts are available so they can be applied to the capacitor.



An 82K resistor is used to limit the current through the reforming capacitor. Some means is needed to know when the capacitor can withstand the applied voltage. A meter would be nice, but expensive. A neon bulb connected across the current limiting resistor will be extinguished when the current is less than about 1 ma.

Since the voltage was available, and the drain was light, it was decided to include a leakage checker for paper capacitors. Only four additional parts were required: a 200 K resistor, a NE-2 bulb, S3, and J3. This makes possible a quick and simple, but positive leakage test for tubular condensers.

Construction of the rejuvenator-leakage tester is straight-forward. Wiring is critical only to the extent that everything should be inside the 4"x5"x6" box used to house the project. The voltage doubler was assembled on a terminal strip before mounting it in the box.

The neon bulbs used as indicators were GE plastic encased units that mount snap-in fashion without need for other hardware.

Test leads using insulated clips are a must since there is as much as 300 volts applied to them when the instrument is in operation.

An accessory socket was added so that power from the 6.3 volt winding and voltage doubler could be used to operate one-tube projects. Some enterprising builders might use the spare room inside the case for "the Lazy Man's Coil Evaluator" described in the June '63 isue of 73. This section could be calibrated for capacitance measurments as suggested in the original article.

Labeling of the original unit was done by typing the label on a narrow strip of paper. This was held in place by the nef clear plastic tape. Decals with proper lettering were not obtainable. Doubtless, more attractive schemes can be found for this part of the project.

To rejuvenate a capacitor, connect its negative lead to the ground jack and the positive to the voltage divider terminal. The voltage level should be at zero during connection. After it is properly connected, advance the voltage level control to the first position. The indicator light in the circuit should light briefly. Leave the switch in this position for a few minutes, then advance it to the next level. Repeat this procedure until the capacitor is charged to its rated voltage. With the five steps used in the original model each advance represents an increase of 60 volts. CAUTION: Before attempting to disconnect the rejuvenated capacitor, return the voltage level control to the zero position. This shorts the capacitor, thus discharging it.

The instrument produces only a little over 300 volts. However, no capacitor reformed to this voltage by the author has broken down in any circuit using up to 400 volts.

To use the leakage checker section, simply connect the capacitor to the appropriate leads and depress S3, which is a spring return switch. The leakage test lamp should blink only once. If it blinks on continously, the unit under test is leaky. If it fails to blink at all, the capacitor is probably open. The range of values over which the open test is effective is .001 to .5 mfd. Releasing the switch discharges the capacitor.

. . . WØHMK

KWM-2 Voltage Regulator

I use the KWM-2 transceiver on CW and found the keyed signal to have a chirp when driving a KW amplifier. This was caused by the amplifier loading down the line voltage a few volts.

The voltage regulator described here was installed, and the chirp was eliminated. Only the plate and screen of the vfo is regulated.

The VR assembly is a modified tube socket with an OA2 voltage regulator tube plugged into it. The modified tube socket along with the VR tube plugs into J-26, a spare phono jack on the chassis.

Underneath the chassis, the spare phono jack is wired to the former voltage divider consisting of R-73 (15K) and R-131 (33K), with the necessary change made as shown in the diagrams "before" and "after."

If the noise blanker is used, the VR tube is wired electrically the same, but must be physically mounted in another position since the noise blanker uses J-26.

The VR tube holder is made from an Amphenol seven pin "Zip-In" socket. All pins protruding from the bottom that are normally soldered to are removed except pins one and seven.

An RCA phono plug is pushed over the center connection and a stiff piece of bare wire soldered from there to pin seven. The center post of the phono plug has its connection made by running a piece of insulated hook up wire, with one half inch of insulation removed, down through the center of the tube socket and soldering it to the center post. The free end of the hook up wire is bent down the side of the tube socket and soldered to pin one. The assembly is then plugged into J-26 and the tube installed.

There are three things to do underneath the chassis. First, remove the ground from R-131. Second, tape the end of R-131 so it will not short to anything. Third, run a wire from J-26 to the junction of R-73 and R-131.

When using an OA2 as a regulator, the theoretical value of the series resistor (R-73) should be 8.8K. A resistor was tried shunted across the 15K to give that value, but the chirp was not present with the relatively high value of 15K, so the original value was left in place, reducing the number of changes made to the unit. With the smaller value of series resistance, the OA2 glows with a brighter light and draws more current. Regulation will take place as long as the tube glows and does not extinguish at any time.

. . . WA4NXC

WB2CQM

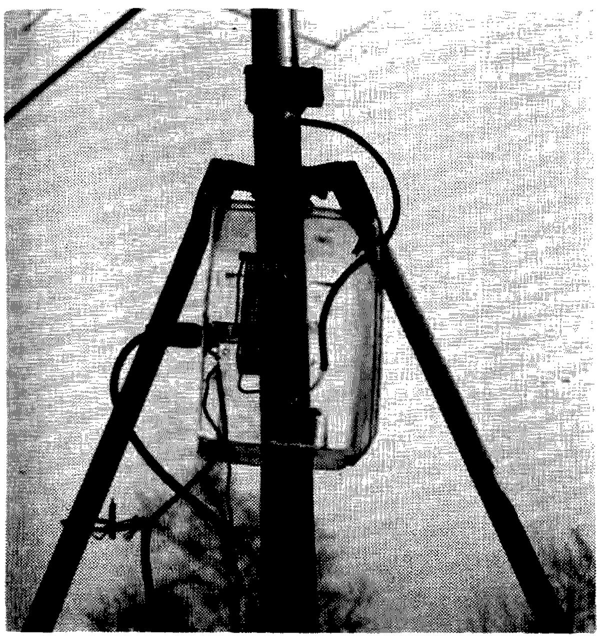
Hi Q 80-40 Meter Vertical Antenna

80 meter operation has enjoyed considerable interest by both the General and Novice amateur. The reliable but generally moderate transmission range has been welcomed by the "old time" amateur for trouble-free "local" round table "rag chews," whereas, the novice, because of FCC restriction, is relegated to this particular niche in the spectrum.

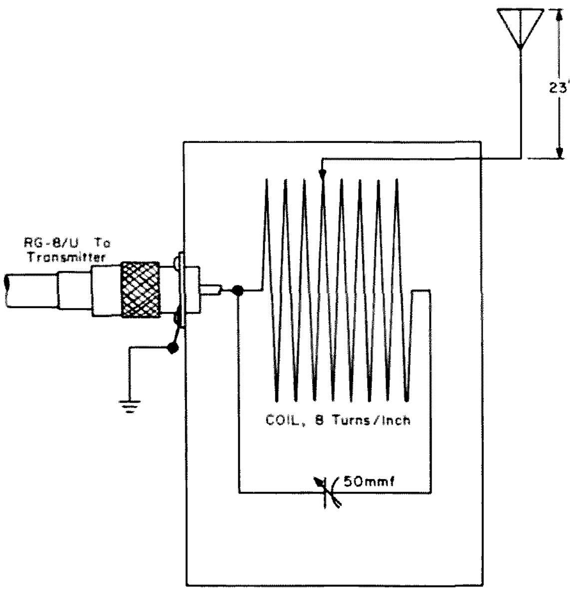
To secure maximum transferral of power, the time proven half-wave dipole has been the standard method of radiation; however, few operators are fortunate enough to construct this type of system due to the demanding erection area. As a consequence, the vertical base loaded antenna has been the logical substitute. Notwithstanding several inherent defects, the small space requirements and low angle of radiation justify its employment.

Construction

The radiator segment is constructed from two 12′ lengths of telescoped aluminum tubing. The lower base section is ¾″ diameter, and the upper section is ⅝″ diameter (both .058″ wall) and telescoped about one foot. The uppermost part of the base section was slotted lengthwise and a ⅞″ stainless steel clamp positioned to secure both elements.



The coil assembly is the most electrically critical component feature. A HI-Q ratio was chosen to insure sharp attenuation of spurious harmonics since the proximity of a number of concentrated city-located television antennas



COIL ASSEMBLY

would normally have led to serious TVI complaints. The coil was constructed from #14 magnet wire stock. A tin can of 3½ inch dia. will serve as the coil form. Approximately 12-14 turns were close wound and removed from the form. Adjust 8 turns to occupy 1″ insuring that equal spacing has been provided throughout. In order to reinforce the coil, short lengths of polystyrene strips (¼″x1½″) were placed across the winding and glued with liberal amounts of liquid polystyrene or Duco cement for low loss. One strip can be made somewhat longer and a hole drilled to allow for subsequent securement to a 3½x5x7″ plastic food container. The container will afford a measure of protection from direct moisture accumulation. One end of the coil is soldered directly to the center terminal of a mounted SO-239 connector. A moderately spaced 50mmfd variable capacitor is placed across the coil to allow for initial tuning and/or retun-

ing due to minor frequency excursions.

A short length of 58U cable is soldered 10 turns from the input terminal and the other end is connected to the vertical antenna base. A grid dipper tuned to desired frequency will assist in adjusting the capacitor-coil factor once the entire antenna assembly is operative. A resistive bridge placed in the line will indicate the characteristic 30-35 ohm resistive load. The antenna is coupled to the transmitter via 50 ohm cable with a minimum SWR reflection. A reasonably non-floating ground is necessary at the transmitter and SO-239 connector for proper loading and propagation.

For those interested in tuning the vertical for 40 meter operation, either a remote or manual low-loss ceramic shorting switch might be integrated to shorten the coil length to 4½ TPI from the input terminal. As a consequence, the assembly will be resonate at 7mc.

Although antenna placement is not especially critical, some care should be exercised to prevent resonating the vertical supports of neighboring TV antenna or similar power-absorbing objects.

The HI-Q characteristics of the coil results in a sharp dipper null at the operating frequency and will insure a maximum transferral of RF potential. . . . WB2CQM

Transistorized AFSK

An AFSK unit using a unijunction transistor develops a saw-tooth oscillation, not a sign-wave, but it has workerd very satisfactory on 2 meters with the W6NRM TU.

I built the original unit on a breadboard and it still is functioning well with its self contained battery supply.

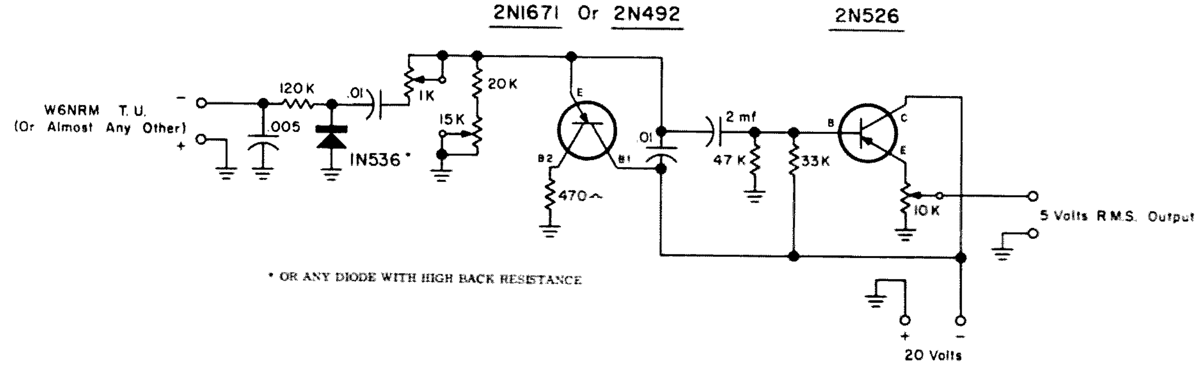
In operation, I merely unplug the frequency shift cable running into the transmitter and insere into the transistor AFSK and adjust the frequency shift control on the TU to give the proper shift as indicated on the tuning eye and scopt.

In the unit I used a 2N492 transistor which is rather expensive, but a 2N1671 Texas Instrument should work as well. The voltage used was 20 to 30vdc. Caution must be taken in conjunction with the unijunction not to ground the emitter in operation, for this will damage the junction.

5V rms was developed on the audio output which will drive any audio circuit.

The unit may be used as MCW oscillator by breaking the battery supply and inserting a key.

Joel Eschmann K9MLD



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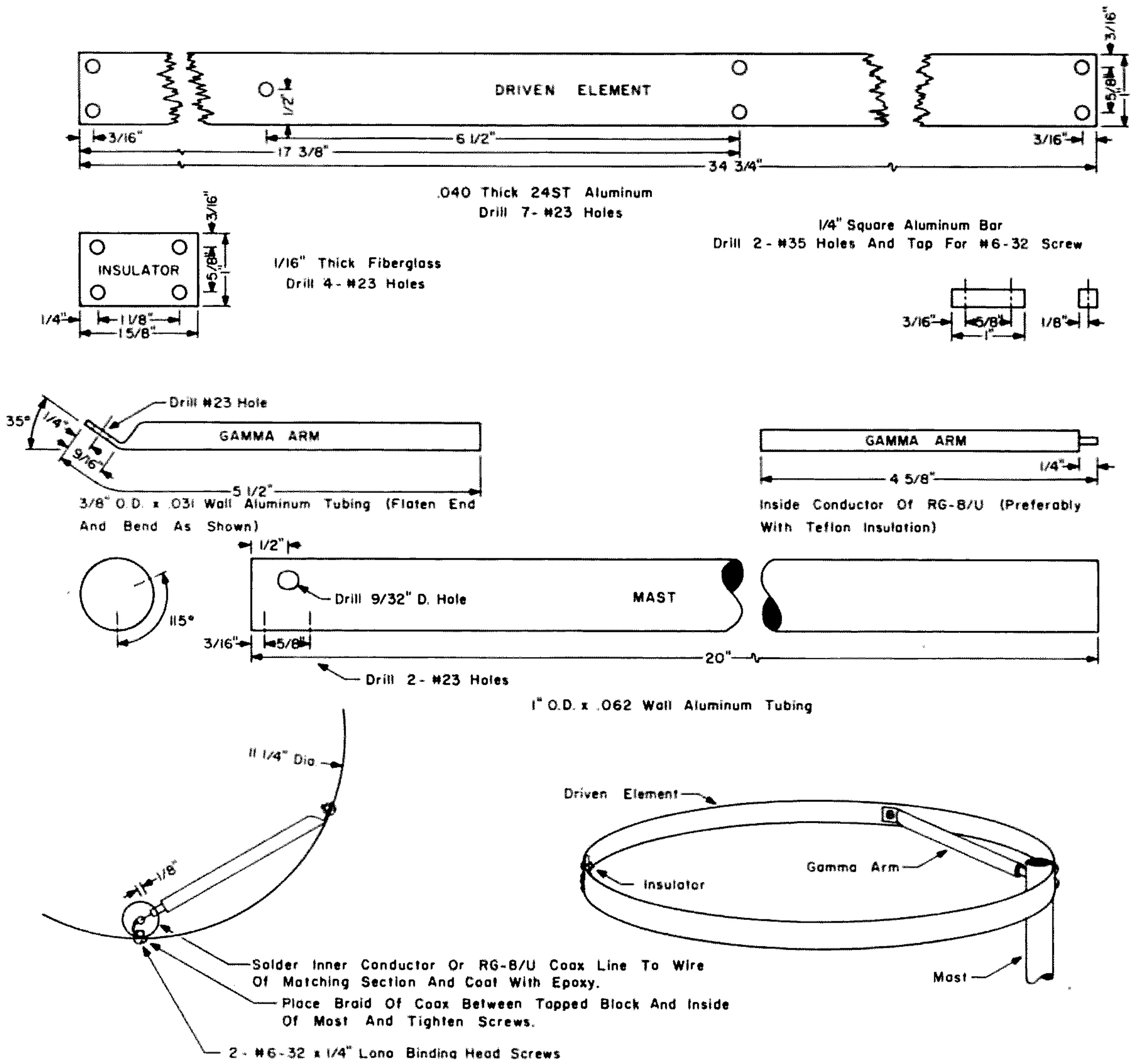
Centerport, L. I., N. Y.

TWO METER MOBILE SPECIAL

A 2 Meter mobile installation that is capable of optimum performance and can be installed or removed in about 2 minutes was my objective, allowing the same transceiver to be used for both home and mobile operation. The principal features of this installation are a simple platform for the transceiver and a new halo antenna held in place by a magnet.

The 12 volt power plug for the transceiver is wired in permanently, but this could be



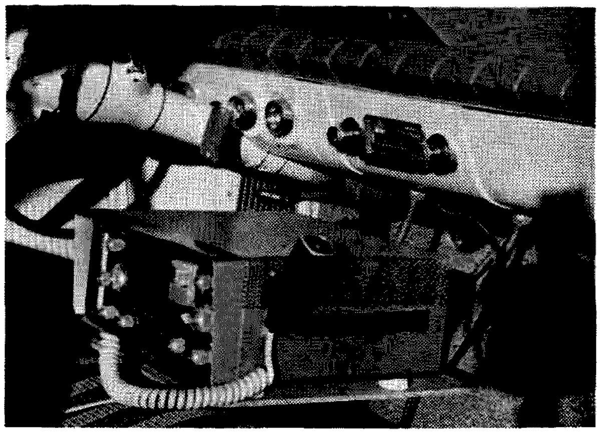
easily replaced by the usual cigar lighter receptacle plug.

The platform for the transceiver was made from masonite with four plastic cups of the type used under table legs fastened on the platform to prevent the transceiver from sliding. Two metal straps are fastened to the front of the platform to which are attached springs with metal clips bent to hook under the lower edge of the car's dash board. The rear edge of the platform has two holes through which a piece of venetian blind cording is threaded. The cord is tied to a piece of wood which holds against the back edge of the driver's seat.

With the platform hooked to the dash board, adjust the cord to hold the platform's edge on the edge of the front seat.

The transceiver will now have a nice shock mounted base and its front panel will be in a most favorable position for operation by either person in the front seat. The antenna cable is routed under the front seat and out the rear window to the antenna.

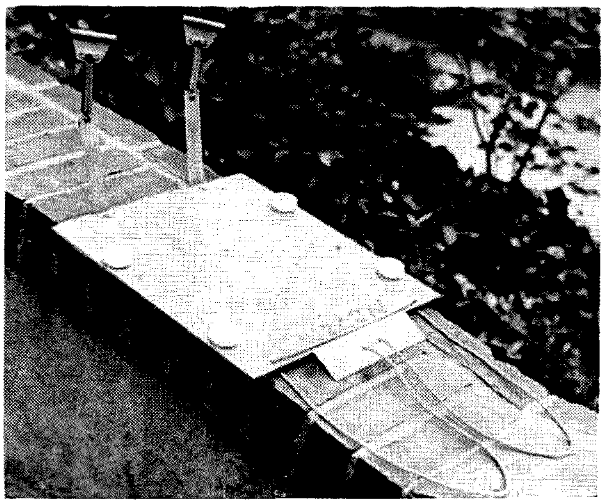
The antenna used is a Halo designed especially for this installation which is light weight and very simple to construct. The aluminum tubing used was 20 inches long (approx. ¼



Details of transceiver installation.

wavelength) to allow placing the halo in the center of the car's metal roof. A surplus magnetron magnet holds the antenna to the car roof at all legal speeds and then some. Thin mylar type was used on the pole faces of the magnet and a plastic plug cap was placed on the tubing's lower end to protect the car.

The halo antenna's element is made from flat stock of 24 ST aluminum which is the springy variety. This allows bowing a flat piece into the circular shape. A simple gamma match made from a piece of ⅜ aluminum tubing having a short piece of wire (inner part of a piece of RG-8/U) inside of it for capacitive



Platform for transceiver.

coupling to the tubing. No adjustments are included for the VSWR should be under 2:1 over the 2 meter band if it is constructed as shown. The nominal impedance of this halo is 50 ohms. The spacing between the ends of the main element will increase or decrease the frequency band at which the optimum VSWR is obtained.

The performance exceeds that of the other 2 meter mobiles in our CD net and has been completely satisfactory in all respects.

. . . W2CJN

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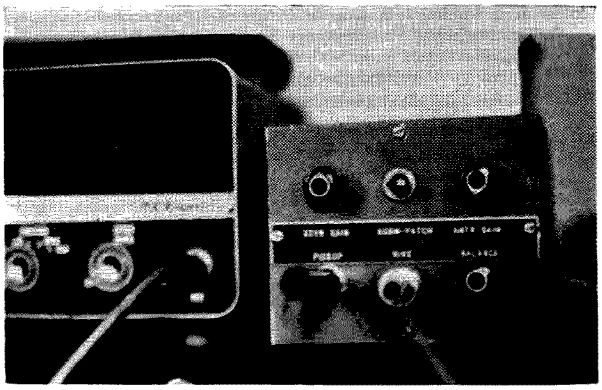
Glen Head, L. I., N. Y.

Mobile Phone Patch
(For Home Use Too)

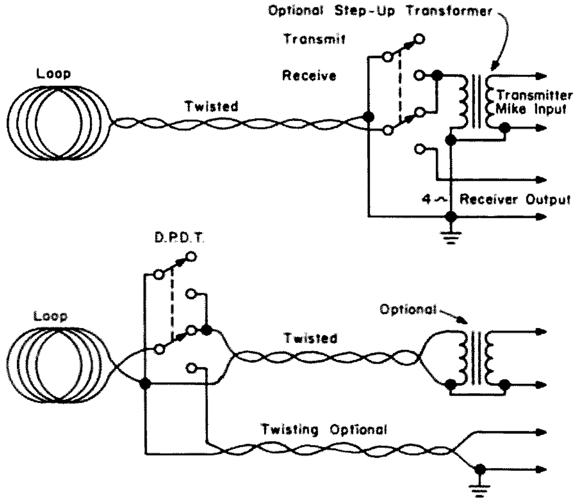
Have you ever been mobiling through a strange town, or even your own area, and worked someone who said to you half jokingly, "If you only had a mobile phone patch, I could speak to Aunt Emily, or Lisa, my best girl."

Well, you can! The hero of this article, usable at any pay phone without any wire connection (and suitable for use without connections at the home QTH's phone, as well), is a coil of 200 to 500 turns which can be wound using any insulated wire. Any wire size from No. 26 to 45 will do—the finer the wire the better, because of the greater number of turns that can be put on the coil in a given space. The form for winding the coil is any cylindrical surface about 2¼ inches in diameter and at


Patch at home.

least ½ inch long. Since the coil is designed to eventually go around the outside part of the ear piece of a type F, G, or H telephone handset, the telephone ear piece may also be used as the form.

Wind one or more layers of vinyl tape on the handset ear piece or winding form, *sticky side out*. The coil turns are then scramble wound onto this tape (cardboard may also be used instead of tape). The ends are then soldered to leads and taped after sliding the core off the form. The number of turns and their final O.D. will determine whether or not you will be able to leave the "wireless connection," used for receiving the phone signals and transmitting to the phone, permanently in place on your home telephone or not. If you wish to do so, the outside diameter of the coil, plus tape wrapping, cannot be greater than the space between the ear piece and the cradle. This

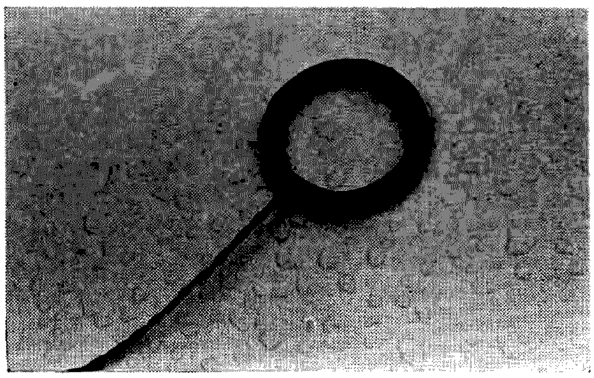


Or Switch Located At Coil End Near The Telephone

FIGURE I

will still allow the telephone to be hung up with the coil in place. If you wish to remove the pick-up and playback loop after phone patching, as you should do at a pay station, then there is no limitation to the outside diameter. The inside diameter should be as close to the ear piece wall as possible and is limited only by the final wrapping of tape used to hold the coil together in one piece and protect it and the leads from damage.

The simplest version of the wireless phone


Pickup-feed coil.

patch consists of the coil, one or two sets of leads, and a double pole-double throw snap or

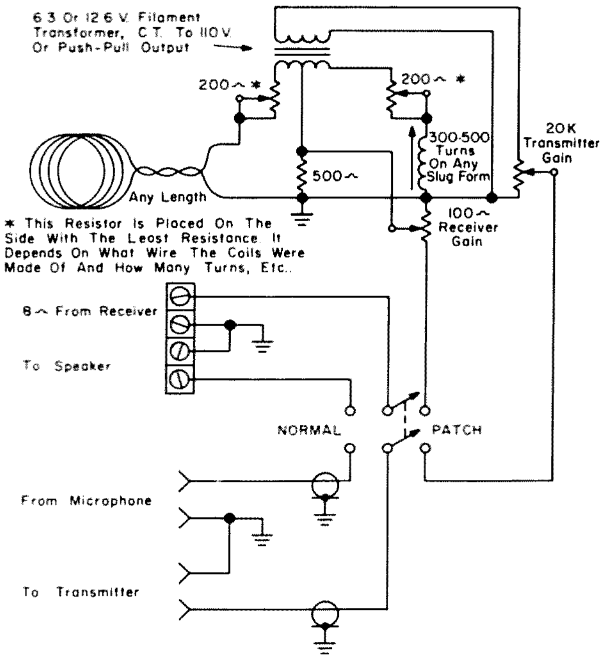
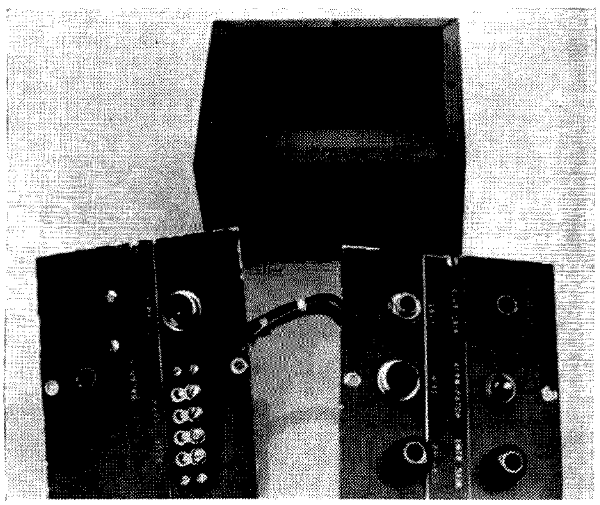


FIGURE 2
"STANDARD" VERSION

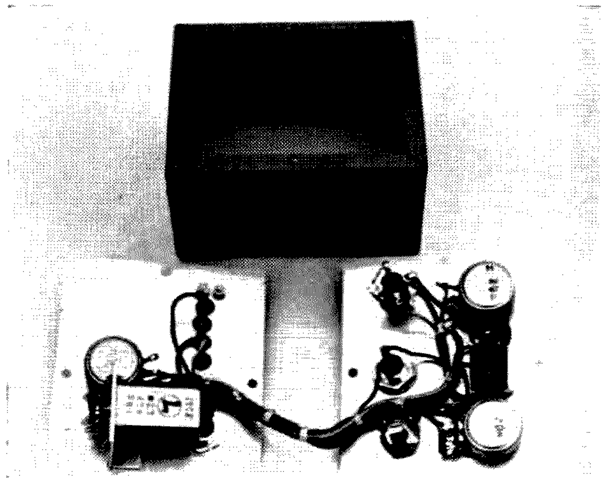
slide switch. Whether one or two sets of leads are used depends on where the switch is placed (at the loop end and of the rig end). Because of the low impedance of the pick-up coil, there may not be enough gain to operate the microphone input of a transmitter directly. In such cases, an output transformer, used backwards, of 1000 to 2000 ohms to voice coil, or a step-down 100 v to filament voltage also used in reverse, or an inexpensive transistor output to speaker transformer may be used to better match the pick-up loop with consequent voltage gain in the mike input circuit (Fig. 1).

The adjustment of the simple patch is accomplished quite easily. With the switch on



Patch disassembled, front view.

"transmit" position, a normal telephone voice is picked up on the patch and the transmitter mike gain is adjusted for proper average modulation. On "receive" position when the output of the receiver is fed to the coil, the level, as heard in the earphone part of the telephone, should be about four to five times louder than you would normally hear on a telephone. A check of the actual level on the line (which is much lower) is easily obtained from the party on the other end, or by making tests with a cooperating friend or ham at the other end of the land line. The reason why the telephone will be four to five times louder is that there is a severe loss of audio going back through



Rear view.

the telephone receiver path back down the line, but much less loss for signals coming into the line from the remote telephone. Monitoring of the patch may be done by using the telephone itself to listen to both ends of the conversation, and you may break in and speak, using the telephone mike for both your own transmissions as well as to talk to the party on the remote end of the line at the same time.

This simple pick-up with a matching transformer may also be used in place of a direct wire connection, if there is enough gain in a standard hybrid phone patch, or, as shown in Figs. 2, & 3, you may construct your own out of junk box parts. In the simplified version (Fig. 2) it is necessary to insert resistance in series on one side of the balancing arm or the other, depending upon which coil has the lower resistance. If the balancing coil has more resistance than the pick-up coil, it is necessary to insert additional resistance in the pick-up coil arm for proper balance. If a pick-up transformer is used, as in the de luxe version (Figure 4), the balancing arm will usually consist of resistance only. The adjustment for best balance is obtained by placing a pair of earphones across the hybrid coil output to the

transmitter. The balance is then adjusted until the sound, as fed from the communications receiver, is heard at the transmitter side at the lowest level possible.

Because of the low impedance of the pick-up loop, it has not been found necessary to shield it. However, it is desirable to twist the leads from the pick-up loop to the transmitter input in order to minimize noise and hum pick-up, because the output voltage induced in the pick-up coil from the telephone is about the same level as that from a microphone. Keep the loop away from power transformer cores.

The same pick-up loop may also be used for recording telephone conversations on a tape recorder by connecting the pick-up loop to the tape recorder in place of a microphone. Similarly, the output of the tape recorder may be played back through the telephone by feeding the low impedance output (4 ohms or so) back through the pick-up loop.

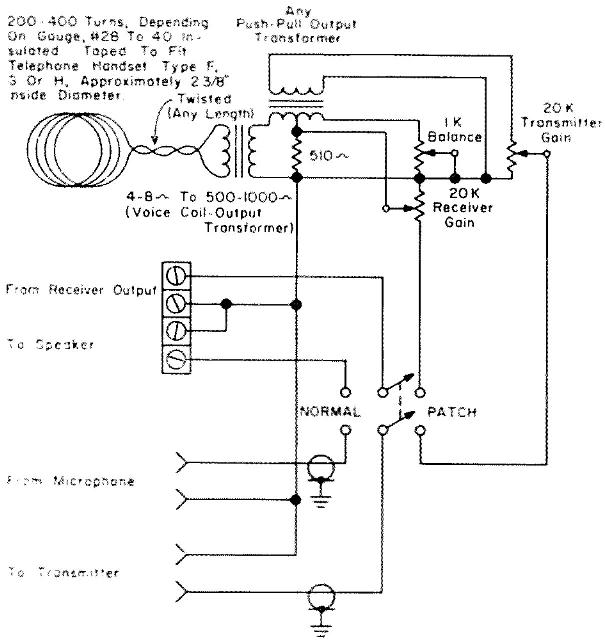
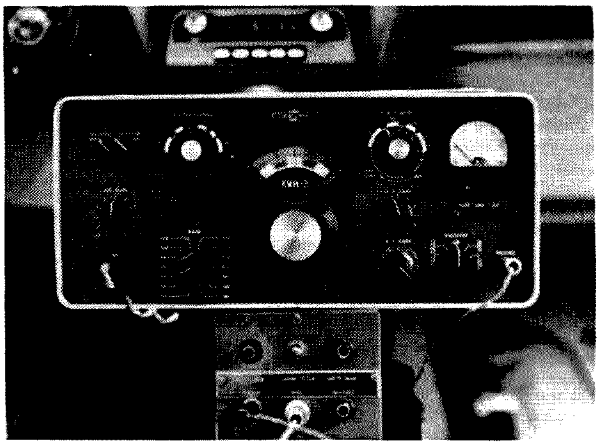
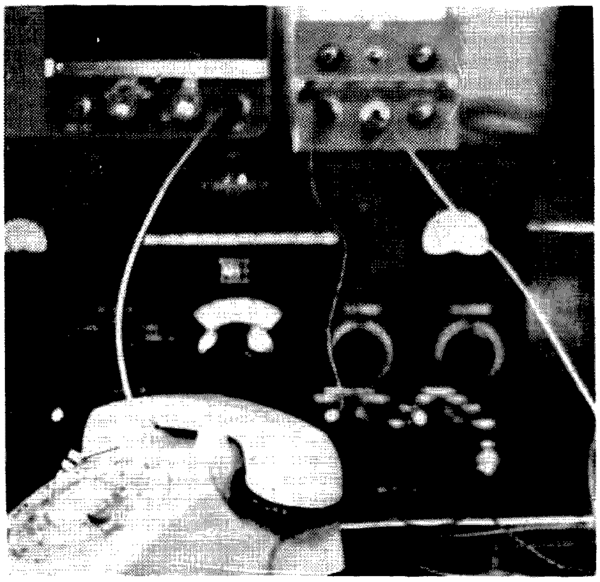


FIGURE 3
"DELUXE" VERSION



Mobile patch.



Note coil in place on telephone.

The pictures show one version of the patch as constructed in a Bud, 3" x 4" x 5" case. One installation is mobile with a KWM-2, the other at the home QTH with a KWS-1.

P. S. After concluding your mobile patch, don't forget to reclaim the pick-up coil and hang up the receiver, before driving away from the pay telephone. You'd be surprised how many pick-up coils you can lose this way!

. . . W2LNP

Operating Notes On The KWM

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6329 Teresa Ave.
Charlotte 14, North Carolina

The notes given here pertain mostly to the operation of the KWM-2 transceiver in the CW mode, and were obtained in a two year period of operation of the unit both on SSB and CW.

On CW, a tone is fed into the audio circuits to activate the vox circuits and generate the output signal. The tone frequency is fixed at 1500 cps and the amplitude is adjustable with the MIC GAIN.

The output signal is composed of several frequencies, all of them suppressed to a high degree except the desired one. The desired signal is higher in frequency than the dial reading by 1.5 kc. Another signal present is the carrier which is at the indicated dial frequency and suppressed 50 db from the desired signal. The degree of suppression is determined by the adjustment of the balanced modulator. When adjusting the balanced modulator, the upper side band should be favored to result in a cleaner CW signal. 1.5 kc below the dial reading is another signal, the lower side band and is suppressed 50 db from the desired signal. The balanced modulator does not affect the degree of suppression on this signal, it is determined by the mechanical filter alone.

If the MIC GAIN is advanced further than recommended, clipping will occur in the balanced modulator and harmonics of the 1500 cps tone frequency will be generated and cause more spurious signals to appear in the output, even through they are outside the passband of the mechanical filter.

To exactly zero beat a received CW signal, an easy way is to match the beat note of the received signal with the internal tone. The level of the received signal and the internal tone should be approximately equal. The internal tone level is adjusted with the af gain and the received level with the rf gain. When they are about the same amplitude, they can be matched in frequency within a couple of cycles or better by tuning for a zero beat between the two tones. This is similar to tuning a musical instrument against a tuning fork. When the signals are matched, the beat note of the received signal will be exactly the same as the internal tone generator, or 1500 cps. When transmitting, the transmitting frequency will be exactly zero beat with the received signal. To keep the transmitter from coming on during the matching, turn the vox gain ccw.

When the band is crowded, the hair line can be set to a reference point on the dial to be returned to when transmitting and the dial tuned to lower the beat note of the received signal. The lower beat note is easier to copy when interference is present. Any interference lower in frequency can be tuned below the audio passband, for instance, the desired signal is 300 cps, and any interference below this frequency will be attenuated by the audio circuits. If the desired signal is 300 cps and an interfering signal comes on higher in frequency, the audio must be inverted to reject this. This is accomplished by switching the EMISSION switch to LSB and retuning the dial 1 kc higher in frequency. The interfering signal will then be on the low frequency side and can be rejected by the audio rejection as before.

When switching to LSB from the CW position, the transmitter will come on for an instant, but no signal will be transmitted. The factory people have assured me this is normal.

When going from receive to transmit, return the EMISSION switch to CW and set the dial back to the original transmitting frequency. Pull out the mic plug to keep the vox from energizing when receiving CW in the LSB mode.

To decrease the vox energizing time, turn the anti-vox gain ccw.

The Heath Q-Multiplier model HD-11 can be used without modification with the KWM-2. Plug it into the Q-Mult jack on the chassis, and it is ready to go. Sometimes L 9 may have to be adjusted for long cable lengths to the Q-Multiplier. This is adjusted so the

receiver will break into oscillation with the Q-Multiplier set to sharp and the peak adj set to 8 or 9. No signal should be in the receiver passband when adjusting this.

When the Q-Multiplier is oscillating, this tone can be matched to the internal tone oscillator as previously described, then when receiving a CW signal in the peak position you will be set up on the same frequency for transmitting, using the Q-Multiplier as a zero beat indicator.

When operating SSB, and it is desired to operate CW without the other operator tuning his receiver, a frequency correction must be made in the KWM-2 when operating Lower Sideband. The correction is to move the frequency dial 3 KC lower in frequency. No adjustment is needed if the SSB operation is Upper Sideband.

When operating at the top end of the band, care must be taken to remain in the band during tune up. For instance, if it is desired to operate on 3999 kc, Lower Sideband, the KWM-2 must be tuned up with the frequency dial indicating 3997.5 kc since the transceiver is operated in the Upper Sideband mode during tune up and the actual tune up carrier would be 1.5 kc higher than the dial reading.

. . . WA4NXC

More Frequencies for the Drake 2-B

The Drake 2-B hamband receiver has fast become an extremely popular receiver. Many operators, however, are unaware that their receiver will tune many of the short-wave broadcast bands and other crystals are not needed.

This is possible because the rf amplifier and mixer are tuned separately (the Preselector) from the local oscillator.

The following table lists the frequencies and bands which can be tuned in this manner. In many cases the preselector tuning is quite critical.

WN4QGQ

Band	Preselector	Crystal	Socket	500	300	100	—100
80	7 to 10	None	—	4.41	4.61	4.81	5.01
40	5 to 4	11Mc.	40	6.59	6.39	6.19	5.99
C	4	18Mc.	C	9.5	9.7	9.9	10.1
C	7¼	11Mc.	C	14.5	14.7	14.9	15.1
C	7¾	18Mc.	C	15.5	15.3	15.1	14.9
C	6	25Mc.	C	11.833	12.033	12.233	12.433

SJS Receiver: Part III

Text for SJS will be found in September & October 73's.

Jim Kyle K5JKX

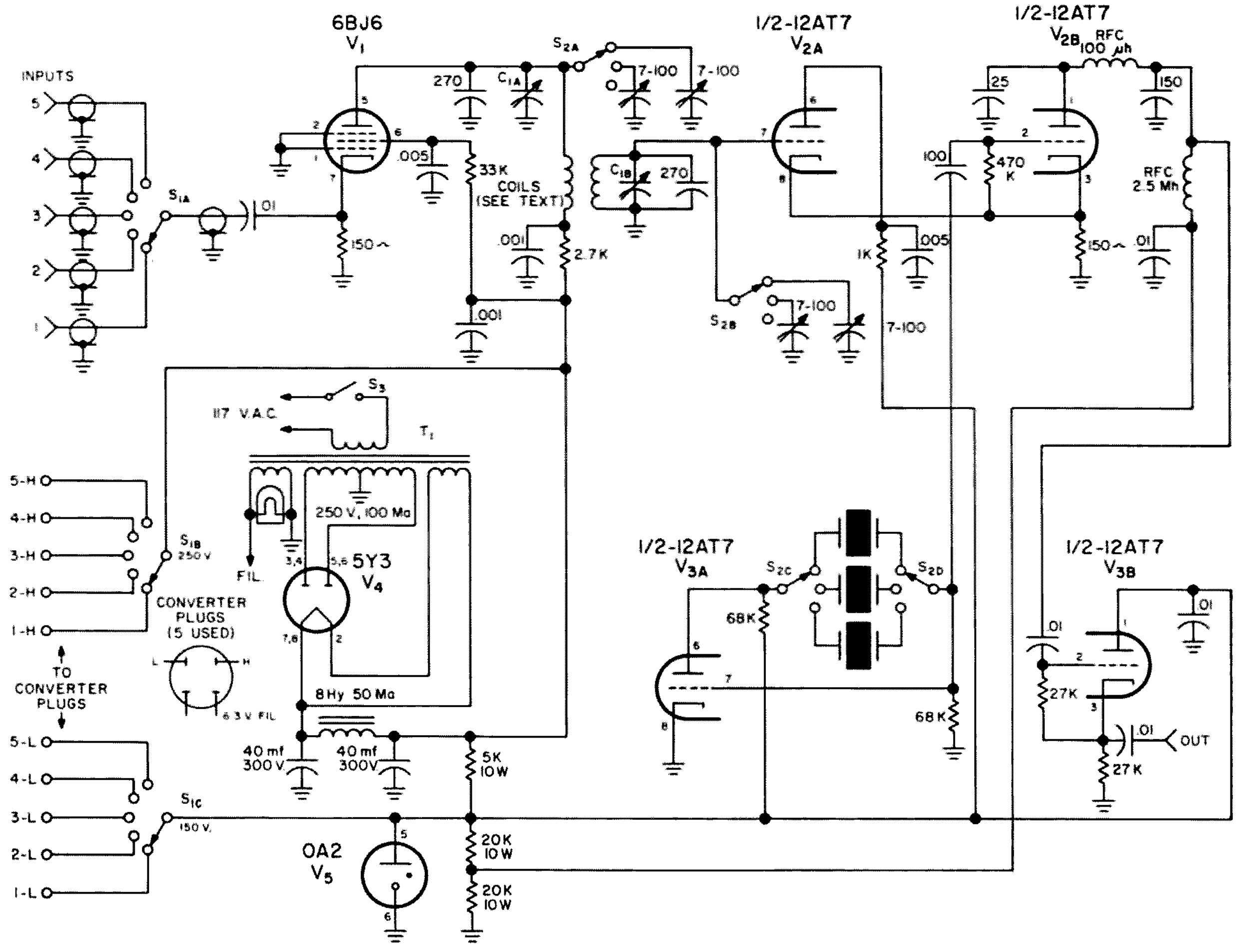


FIGURE 1

Schematc—7000-8050 KC converter

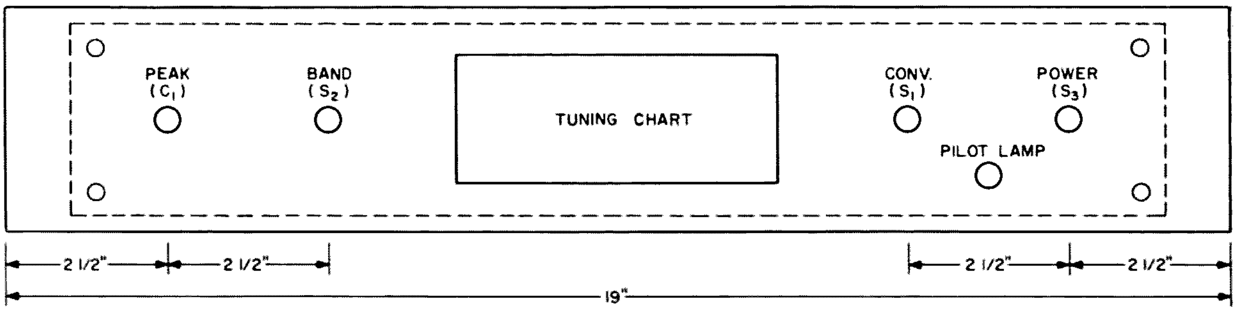


FIGURE 2
FRONT PANEL LAYOUT

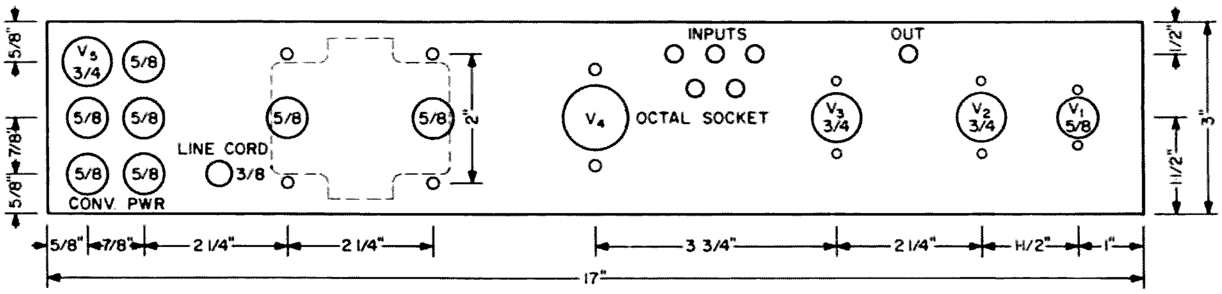


FIGURE 3
REAR LAYOUT

William Hoisington K1CLL
83 Bellevue Ave.
Melrose, Mass.

UHF Transistor Circuitry

Practical Transistor crystal oscillators and VHF-UHF transistor frequency multipliers to 144, 432, and 1296 megacycles, for use as converter local oscillator chains, spot frequency signal generators, and VHF-UHF frequency calibration.

Introduction

As in tube work, going through VHF and UHF up to microwaves, transistor circuits change quite radically. Bypassing, always a problem, is of even greater importance with transistors, due to the lower impedances of their input and output circuits. The use of large but thin (solderable) brass plates, insulated by sticky Teflon tape for bypassing, can be a technique of considerable importance to the amateur experimenter. Teflon is used because, when soldering onto the brass plates *after* mounting, the Teflon does *not* melt. Mica is alright, but it is more fragile and must be glued on or otherwise held.

Nylon anti-shorting bolts are very convenient for fastening the brass plates tightly to each other or to ground so that you will have mechanically rigid and electrically good UHF capacitors. This avoids the use of the shoulder washers which would have to be used with metal bolts, where the shoulders may have to be thinner than the brass plates, which are already only 22 thousandths thick. Also, I hope you won't be fed up with my talking every so often about copper-clad bakelite, but it is the handiest stuff for building UHF prototypes. You can even make shielded boxes out of it.

Circuit and Construction Details

In UHF, where *configuration* and *shape* assume greater and greater importance as you go up in frequency, you eventually wind up leaving out the two-conductor principle entirely and find yourself with hollow pipes otherwise known as waveguides. So, it becomes necessary to talk about the construction along with the circuit, as you will see.

The crystal oscillator is shown in two versions. Some amateurs definitely prefer 8 mc rocks, and have lots of them, and some like the higher frequency ones. I must admit I haven't completely made up my mind yet myself. I like 48 mc crystals fine, but every once in a while I get a jumpy one.

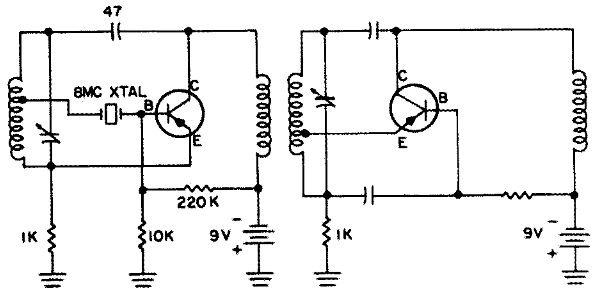


FIG. 1 FIG. 2

Fig. 1 is the circuit used. Note that the phase reversal in the crystal (a positive voltage on one side and a negative voltage on the other) at any given instant, makes this work. When the crystal frequency is reached the phase reversal of the crystal makes it oscillate, but good! A quickie sequence of operation of a pnp transistor oscillator, non-crystal, as in Fig. 2., goes like this. (We will use letters, B for base; E for emitter; C for collector) 1) With no B to E voltage there is no collector current, so C rests at -9 volts. 2) Negative voltage, with respect to E, is applied to B, C then draws current and goes toward positive voltage. As E is tapped up towards the C end of the coil, E is in phase with C. This means that E is moving positive with respect to B which is the same as applying more negative voltage to B. This causes more current, more positive travel of C, etc. When sufficient action of this sort takes place, several million times a second, you have an oscillator. Now go back to Fig. 1. The B and E are reversed. "It won't oscillate." Correct. That is, it won't until the crystal reverses the phase. You may not remember but Paul Curie (Madame Curie's OM) used to travel around France banging on crystals with a hammer to show, by sparks jumping across a gap and wires connected to each side of the crystals, that mechanical compression of such piezo-electric devices did indeed generate electricity. The mechanical compression wave bouncing back and forth etc., does the job. I'm not insinuating that you don't know how a crystal works. But let me know if you real-

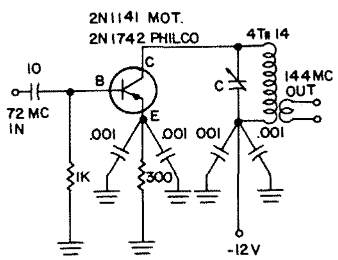


FIG. 3A

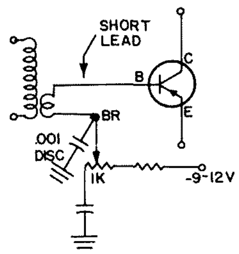


FIG. 3B

ized that it reverses the phase also! So, that is how the oscillator of Fig. 1 not only works, but why it won't take off any frequency except the crystal frequency! No more delicate feedback adjustments, etc. Patent pending.

Frequency Multiplication

When I first started out to double, triple, etc., from 8 mc, I coupled over to the next base, see Fig. 3, with a fairly large capacitor. It worked. After several stages though, each one getting more and more jumpy and hard to tune, I arrived up on 144 mc and the circuit acted as though the tuning capacitors had faulty contacts. Getting desperate I finally *listened* to the output on 144 mc with a tuned diode detector and audio amplifier. What a racket! It sounded like a dozen super-regens all going at once. The remedy was low capacity on the base inputs.

Fig. 3A shows a typical capacity-coupled doubler stage going from 72 to 144 mc. The 10 mmfd input capacity is tapped down on the previous collector coil, 72 mc, to match the base input. Note that there is no external dc voltage on the base. This is developed by rectification in the base-emitter diode portion of the transistor. A collector milliammeter makes an excellent excitation indicator in this case.

In tubes excitation is known as grid drive. Here you are driving the B-E diode. I have a little box full of "Dead Soldiers" reminding me that it is very easy to burn out transistors with rf. If you take care with the input and never exceed the rated rf voltage, maintain a self-biasing emitter resistor, and another in the base return, watch out for creeping collector mills, use proper heat sinks, (what a nuisance *they* are for rf stages) and keep high-powered transmitters away, it just may keep going.

Actually, if you don't try for *watts* out, you can run a 6 transiator local oscillator chain, or low-power exciter from the 6-8 mc region up to 1300 megacycles, and have it keep going pretty good. I have one that I built over a year ago and it still puts out several volts

(not watts) of rf at 1200 mc. It was built as a local oscillator chain for a 1296 converter, and for a test signal.

This circuit is suitable up to around 300 mc. 3B, an experimental set-up, may be used for untuned base inductive coupling—3A works exactly as is. I have it running here now. If you lack sufficient drive from the preceding stage, negative dc bias, actually dc excitation voltage in the case of transistors, may be put on the base also, as shown in Fig. 3B. Otherwise ground point BR (base return) through a resistor which may be checked as per rf drive available.

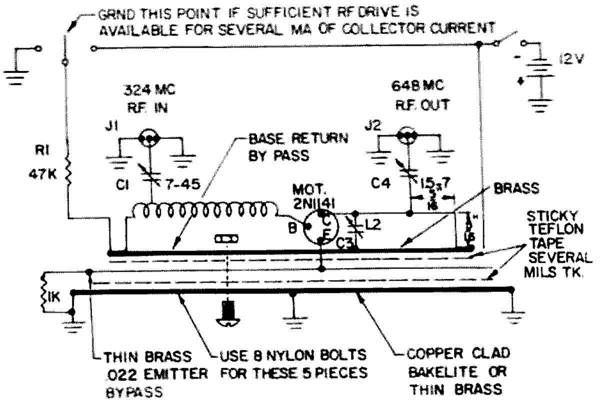
Did someone ask about protective bias? The emitter has 300 ohms in this circuit. I usually start off with one thousand ohms. However, in frequency multiplication there is an optimum point for the three parameters of rf drive, base resistor, and emitter resistor. The fixed values shown are working. In case you want to experiment yourself, a variable circuit can be used.

Going Up

Above 50 megacycles the collector inductance becomes increasingly important. At 300 megacycles I have achieved a good Q, lots of good rf volts (this means anything over a volt with reasonably priced transistors at these frequencies) by the use of copper strap coils, and very short disc-cap bypass leads using several at each point, such as the collector return and emitter lead.

Another Bug. Transistors are very capable of putting out almost any ratio of volts at the fundamental to volts at the multiple frequency. Example: while working with the 650 to 1300 megacycles shown in Fig. 5., at times my rf output detector was off scale at 650 megacycles, while the 1300 mc detector showed less than 10 microamperes. The doubler stage shown however is the other way around, off scale at 1300 and very little at 650! It also tunes like magic and even is quite active on the collector current meter when tuning thru 1300 as a doubler.

Back to 300 mc again, briefly. By using a collector "coil" of copper strap, the Q is raised, undesirable frequencies lowered, and more rf is stored for use in driving the next stage. I have one stage, as per Fig. 3A, doubling from 150 to 300 megacycles, for use in going to 600 and then 1200, which has a collector coil of 5 turns of 3/16 wide copper strap, parallel tuned by a store-bought rotating variable capacitor, Hammarlund Mal. type to 300 megacycles. I still think a parallel-tuned coil at 300 mc is pretty good!



NOTE: C3 = 1.5-7MMF, HAMMARLUND TYPE MAC

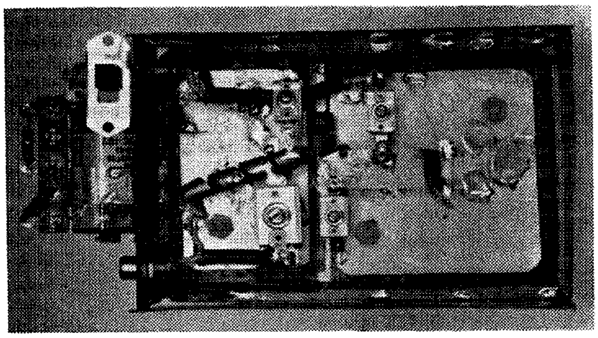
FIG. 4

UHF Doubler

The Transition Region

This is where coils become straps, or "line" circuits. Above 300 mc things begin to get tough, as mentioned. Fig. 4 shows a good working doubler, 300 to 600 megacycles. (or 650; don't mind my losing or adding a mere 50 mc, please). Find photo. The use of an insulated emitter ground plate on top of the dc main, or "chassis" base plate allows efficient emitter bypassing for frequencies above 1200 megacycles. Bolt all plates together with eight 6/32 nylon bolts and nuts. Again, Teflon tape allows soldering *after* assembly. Next comes the base-return and collector-return bypass plates. These also allow bypassing to over 1200 megacycles and *form part* of the circuit as you will find out if you put anything between them and the base plate. Begins to look like part of a waveguide? Right the first time. The transistor socket emitter lead (yes, the socket is still there on 600 but not on 1200!) can be soldered in next. Use as short a lead as physically possible. Then the tuned base strap coil (300 mc) with its 50 ohm input matching capacitor, CI, and its tuning capacitor C2 are soldered in. Then repeat for the collector strap circuit. Due to the efficiency of the ground plate bypassing, the input and output jacks may be grounded directly to the base plate and still get proper rf to and from the base plate and the collector return plate. This allows the coax cable connections to be grounded throughout the rig. (Have you ever tried to insert rf capacitors good for over 1300 mc in RG-58/U?) (First of all you can't *buy* any!)

Rf drive into the base circuit may be tested as follows. Ground the base return resistor RI. With a 0-10 ma meter in the collector circuit apply the collector voltage. I would advise sticking at first to minus 12 volts. Try



Doubler

more later if you have plenty of spare transistors for these frequencies. The collector current should read zero. On the application of rf drive at 300 megacycles, some tens of milliwatts, with a Motorola 2NII4I as shown above, and the base circuit LI-C2-CI tuned, the collector meter should rise. At somewhere between 5 and 10 ma the doubling output will be at a maximum. L2-C3 should be tuned by watching an output meter plugged into a power-detector cavity as described before. I must repeat, it is of ever increasing importance as one goes up in frequency multiplication, to have an rf power detector that tunes positively over a wide enough range to take in both the fundamental and the *expected* multiplication frequency, (but not at the same time) and show you how much of each is present in the collector output circuit. J1 and J2 are "phono" jacks. Suit yourself on that question. At least they work and don't cost much.

Doubling vs Tripling

Before going to the final unit, with which you can get a good stable signal, modulated if you need it, on 1296, or use it as a 1296 crystal controlled local oscillator chain, this seems like a good time to mention why I like to use doubling instead of tripling when going to over 200 or 300 megacycles. Some time ago I learned, while making and tuning up crystal controlled 50 to 100 watt cavities on UHF, that doubling always produced more power than tripling. This may seem somewhat obvious, but it is the overall plan that counts. If you look back to the pre-war days of 5 meters, you will see that the bands were then 160, 80, 40, 20, 10, 5, 2½, 1¼, etc. This was for *doubling* and to make the harmonics fall into other amateur bands. At any rate, I hereby present my main reasons.

1) It is just possible, by pushing things, to maintain rf power up to 1200 megacycles by doubling. If you triple you won't. Oh yes, you *can* interspace *amplifier* stages *in-between,* or use $80 disc-seal beam power tubes. However, I'm naive enough to think that if I can't afford them, most other amateurs can't either.

2) The *undesirable* frequency content is less when doubling. If you go up in frequency, the first wiggle of the plate meter (don't expect too much from a *transistor* collector meter) and the first jump on the rf output meter will be at *twice* the frequency, which is doubling. Don't ask about push-pull. Did you ever see a push-pull coax cavity? It can be done, but not now, please.

If you are tripling you have to tune up past the nice big bang at the doubling frequency and then find the much smaller peak of energy at 3 times the fundamental.

3) Lots of good tubes are almost through in ¼ wave plate line coax circuits at 1200 megacycles. If you want room to tune around you have to use 3 quarter waves on the plate line. We will take this up again later, but the idea here is that the ¾ wave cavity tuning point of 1200 mc is quite removed, when doubling, from the fundamental tuning point. Believe me, this helps. As a last word I just checked doubling vs tripling, to 1300 mc, with a low-cost ($2 to $3) transistor. Almost three times the power out with *doubling.*

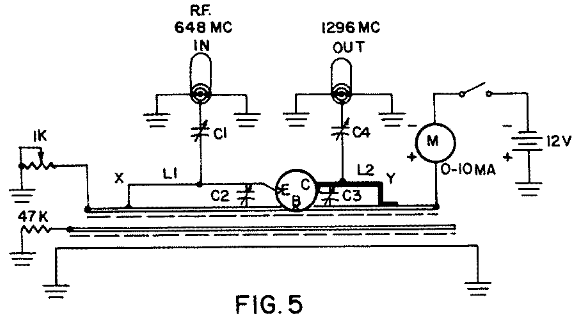


FIG. 5

Schematic—1200 mc doubler

The Tough One

Next we double from 600 to 1200 megacycles with a low-cost transistor. The circuit, Fig. 5, and the photo, look similar to the preceding stage, but there are some differences. Most important of all, the base is now grounded instead of the emitter. Perhaps the term "common-base' describes it better. LI is now tuned to 648 and L2 to 1296. This latter takes a little doing, and is right near the end of the line for transistors in little thin cases with thin leads, all on one end. However, it does work and puts out good stable volts of rf at 1296 megacycles with only a trace of 648 in the output. I do have a good coax circuit with a $20 *coax* transistor in it that is even better, but who wants to pay $20? The 1296 mc collector circuit, its tuning, and output connection, are a little fussy, as I mentioned, but after all, look at the waveguide microwave circuits they use on L band

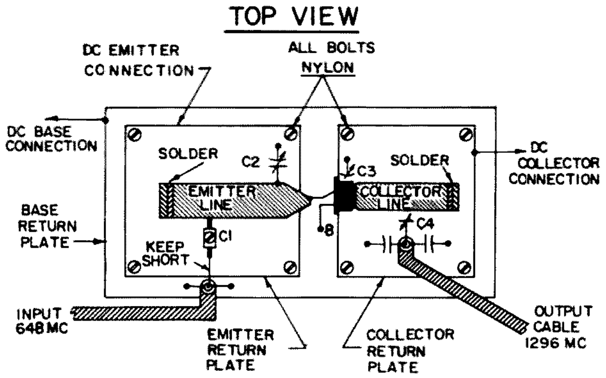
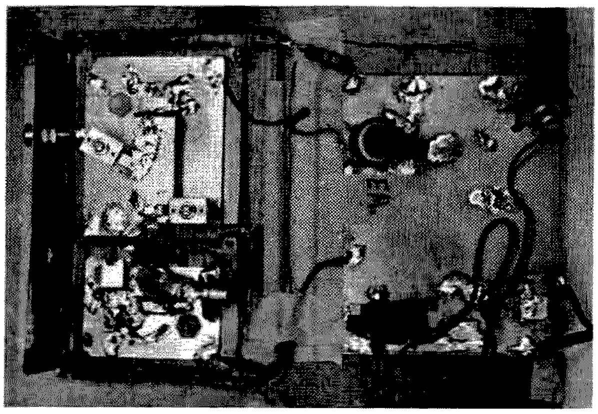


FIG. 6

Layout—1200 mc doubler



Photo—1200 mc doubler

and the fantastic $ they get for them. So, amateurs, in line with the "Amateur Service" idea, let's go.

In Fig. 5 the actual dimensions used are as follows. LI is 1¾ inches long from the transistor to the point marked X. It is made of ½" wide brass strap .022 thick. CI and C2 are very small mica compression trimmers, .9-7 mmfd, the kind with about ¼ of a plate on one side. Solder this side to the inductance LI.

L2 is 7/16" long from the top of the transistor can to point Y. L2 is soldered directly to the can of the transistor (I can see Motorola engineers falling on the floor in a dead faint, but it still works). Note that in the Motorola 2N1141 the can is also the collector terminal. Or perhaps I should say that the collector is also tied to the can, because it already has its own lead. In this circuit just cut that lead off short. The can is *not* the collector in lots of other transistors, so watch that. Again, I say, 1296 isn't just any old dc band.

C3 is a spring strap about ½ inch long soldered to the collector return bypass plate, with a nylon 6/32 bolt adjusting its distance from the collector can. It also has Teflon tape on it. C4 is a copper tab ⅜" wide by about ¾" long soldered to the output jack, also with tape for insulation.

Fig. 6 shows the top view (1 said it was a *little* fussy). CI goes to a front panel jack. The front panel is brass and is soldered to the ground plate. The plate type bypassing allows the 600 mc to get over to LI but keep everything short, short! The output assembly may be mounted on a small extra plate mounted on the collector return plate, insulated from it by the usual means described here. This keeps the collector negative voltage off the cable. It is only minus 12 to maybe 18 volts, and you won't feel it with your fingers, but there is no use finding next day a lot of applesauce running out of one end of what was a good battery.

Suggested crystal frequencies for oscillator-multiplier stages to UHF. For 144 mc, 48 mc; for 432 mc, 54, 108, 216, 432.; for 1296 mc, 27 mc, then triple to 81, then double to 162, 324, 648, and 1296.

. . . K1CLL

Tima Popovich ex-YU1FR

6m QRP Station

The unit described in this article proved the theory that it is possible to establish contacts at quite respectable distances with very low power.

Designed primarily for mobile use, the station is operated from a six volt battery. For 12 volt operation, the heaters will have to be rewired and changes made in the power supply. An ac supply is included, making it a station for all-around use.

Before going into the details of construction, here is a brief description of the various parts:

Transmitter

The oscillator is a Jones circuit which, compared with other circuits, furnishes a high range of potent harmonics. The crystal is of the highest possible frequency so that enough drive is available for the final. The final uses push-pull 6AK5's which, at low input, give 1 to 1½ watts of output. 6AK5's were used because of their low heater drain (175 ma) and good high frequency efficiency.

Receiver

The receiver is a superhet with a regenerative detector. This gives the best compromise between battery drain and performance. 6AK5's were used wherever possible to reduce battery drain. The lineup uses a 6AK5 oscillator, 12AT7 cascode rf amplifier, 6AK5 *if* amplifier, 6AK5 regenerative detector, and 6AK5 audio output. The output is enough to drive a pair of headphones or a small, sensitive, speaker. If more output is desired, a 6AQ5 could be used at the most of higher battery drain.

Modulator

The modulator is extremely simple, consisting of one tube. A carbon microphone provides enough output to drive a 6AQ5, plate and screen modulating the final amplifier. The microphone is coupled to the 6AQ5 through a carbon microphone transformer. The quality is good and there is plenty of modulation.

Power Supplies

There are two independent power supplies

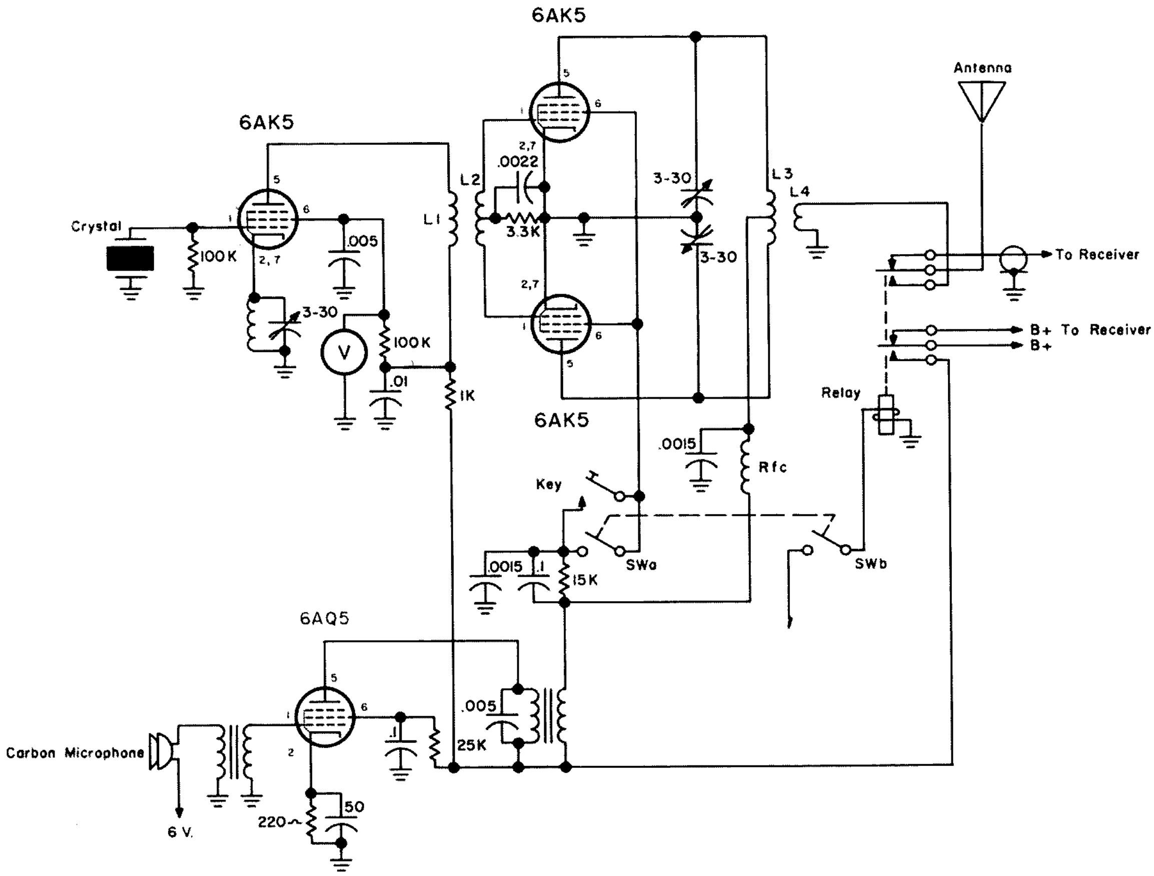


FIGURE 1
QRP transmitter.

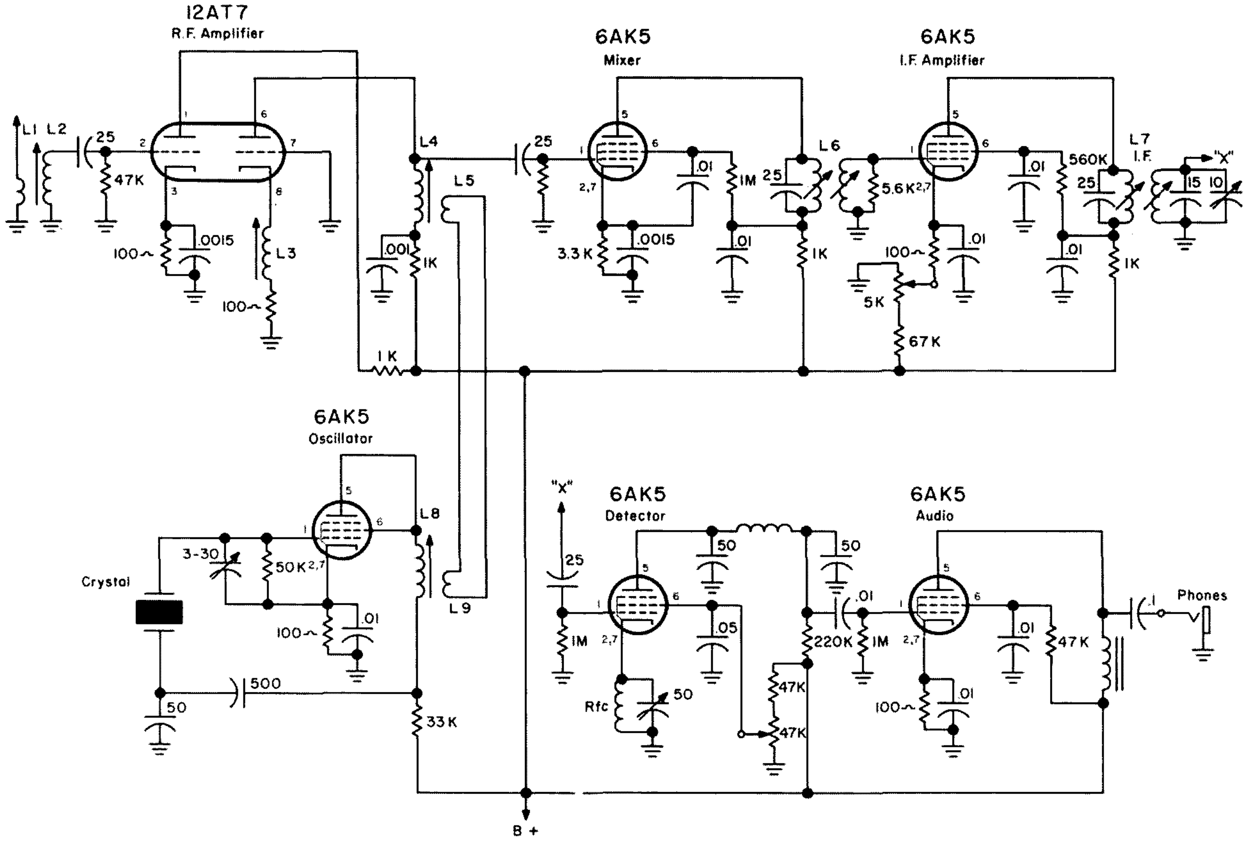


FIGURE 2

Receiver. Add 100 mmf capacitor from pin 1 to pin 8 of 12AT7.

in the transceiver. The mobile supply is a conventional vibrator supply delivering about 200v @80 ma. The ac supply is also conventional and delivers the same voltages in addition to rectified and filtered low voltage dc for the operation of the relay and microphone.

Now that I've given you a description of the transceiver, the next step is to drag out the soldering iron and begin the construction. The schematic for the transmitter and modulator is shown in Fig. 1. The Jones oscillator is of the cathode feed-back variety, the feed-back being caused by the rf voltage drop across the rfc in the cathode. A small rf choke in parallel with a 3-30 mmfd trimmer is used. The trimmer adjusts the amount of feed-back to compensate for the lack of activity of some crystals. To adjust this, use an inactive crystal and set the trimmer so that the oscillator cuts in smoothly and reliably. This setting will be good for all other crystals. The choke in the cathode consists of #28 wire close wound 1" on a ⅜" slug-tuned form. The crystal can either be 12.5 or 16.5 mc. The screen supply of the oscillator has a form of voltage regulation caused by feeding voltage through a 10K re-

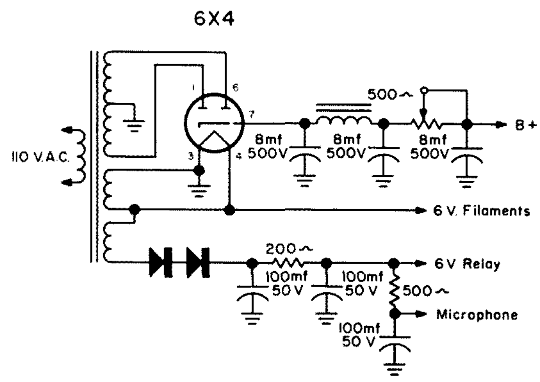


FIGURE 4

AC power supply.

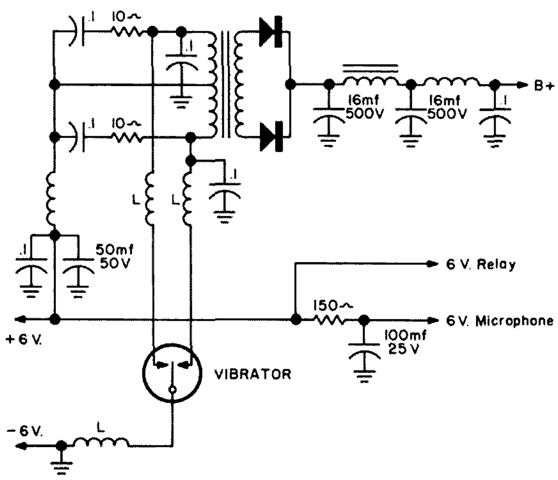
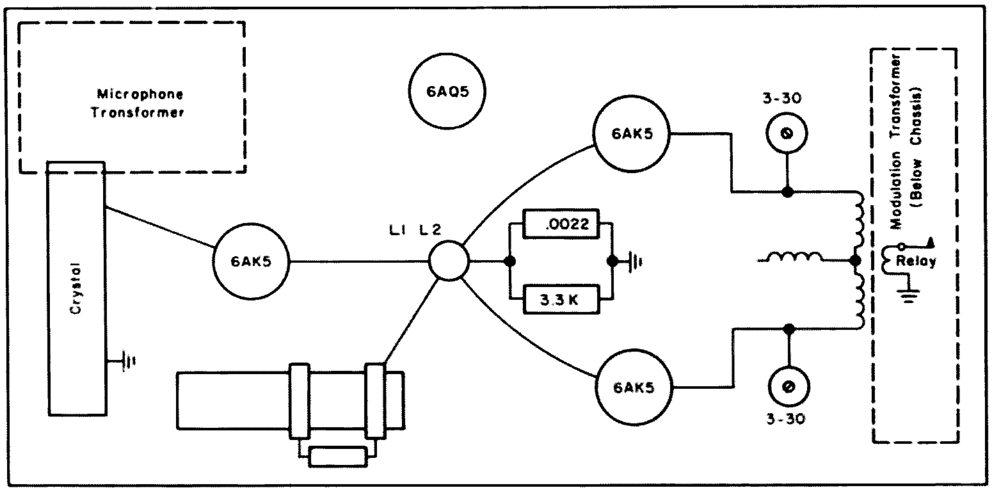


FIGURE 5

6 volt power supply.



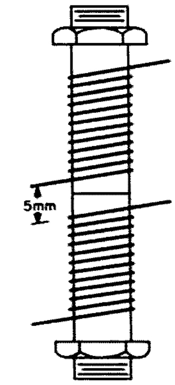


FIGURE 6
Transmitter layout.

FIGURE 3
Rcvr if.

sistor with an NE 2 or similar neon connected from the screen to ground. The plate of the oscillator is connected to a transformer consisting of LI and L2. The final amplifier is a conventional push-pull circuit with L2 as the grid coil and L3 as the tank circuit. The modulator is not critical as to lay-out, the only precaution being necessary is to keep the plate leads away from the grid leads. A .005 mfd condenser is placed across the primary of the modulation transformer to prevent any undesirable feed-back. Although I wound the modulation transformer myself, this is done because there weren't any available here at the time. The transformer that should be used is a Triad M4Z or similar unit.

The receiver requires that some attention be paid to the lay-out. The rf amplifier is a cascode using a 12AT7 or 6BQ7. Although the cascode was not neutralized, no feed-back or oscillations were experienced. The stage is bandpassed with L2 tuned to the high end, L4 to the center, and L3 to the low end. A 10 mc crystal is used on its third overtone giving an *if* of 20 mc. It is then coupled through L6 to the regenerative detector. An rf gain control is used to prevent overload of the detector. The detected signal passes through a filter network which removes rf from the audio. The audio output stage has a choke in the plate circuit which should be as large as possible when used with phones. An audio output transformer with a speaker could be used instead. The *if* transformers may appear difficult to build, but they are really no problem. The coils are wound on two forms 8 mm (ap-

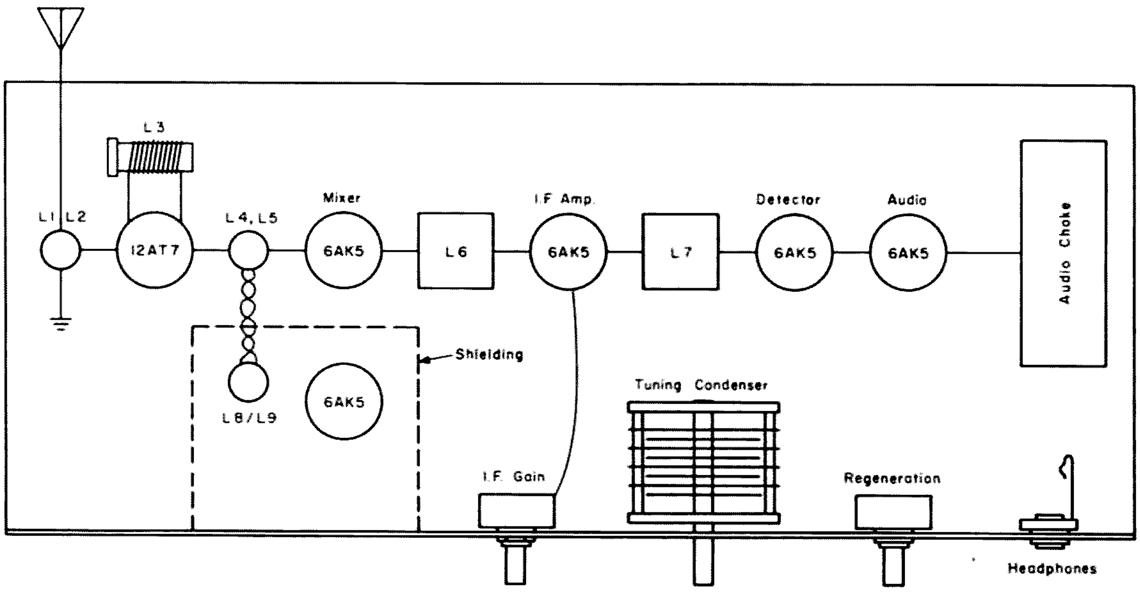


FIGURE 7
Receiver layout.

Coil Table

Transmitter

L1—6 turns #20 on 3/8" slug—tuned form

L2—5 turns ct insulated wire, closely wound over L1

L3—3 turns #12 tinned, 1/2" space and another 3 turns. Coil is 1" diameter, 1" long

L4—3 turns #14 enameled between the two halves of L3

Receiver

L1—2 turns wire coupled to the cold end of L2

L2—9 turns of #20 wire 1/2" diameter 11/16" long with a 20 mmfd trimmer across the coil

L3—7 turns #20 1/2" diameter 11/16" long with a 20 mmfd trimmer across the coil

L4—8 turns of #20 1/2" diameter 11/16" long with a 20 mmfd trimmer across the coil

L8—11 turns #20 3/4" diameter 3/4" long with a 20 mmfd trimmer across the coil. This coil is tuned to 30 mc.

proximately 3/8") in diameter which are joined together as shown in Fig. 3. Standard 21 mc television *if* transformers can be substituted.

The power supplies are standard and no special precaution has to be taken. The two filament windings are connected in series and rectified to provide low voltage dc for the relay and microphone. There is a resistor for adjusting the output voltage of the transmitter. This should be set to about 200 volts in order to prevent damaging the 6AK5's. The filament leads are shielded to prevent pickup of vibrator buzz when used in mobile operation. The mechanical layout for the chassis are shown in Figs. 6 and 7.

Testing and Alignment

Check all voltages and make sure that they are correct. When checking the plate voltage of the 6AK5 detector tube, a click should be heard, indicating that the audio works. The most critical part is the *if* alignment. Using a signal generator or a grid dip meter, couple a 21 mc signal into the grid of the 6AK5 mixer and tune the 2 *if* transformers for maximum signal. If the signal is too strong, the indication of this being a strong whistling sound, it may be necessary to slightly drop the screen voltage of the detector. The oscillator is then tuned to the correct frequency. L2, 3, and 4 are tuned as described earlier and adjusted for maximum sensitivity.

The transmitter tune-up is simpler. Tune the plate circuit of the oscillator to 50 mc and adjust the trimmer in the cathode and plate coil for maximum output. Then insert a less active crystal and adjust the cathode trimmer so that it will oscillate without using excessive feed-back which can damage the crystals and cause poor stability. Next adjust the final coils for maximum output.

The unit is now complete. After using this a while, you will be amazed at the performance of such a simple rig. If care is used, you will have a station for use at home, in the car, or anywhere you care to take it.

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Silicon Diode Noise Limited For Mobile Receivers

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A noise limiter, as any real mobile enthusiast knows, is a necessary evil for the satisfactory performance of the familiar converter-broadcast receiver combination. The installation of this type of limiter usually entails unsoldering and rewiring the second detector and replacing the seven pin socket with a nine pin socket for which a larger hole must be filed or punched. Or, another tube may be installed, often at a distance of several feet and connected to the receiver by at least four dangling wires that pick up almost as much noise as the limiter cuts out.

With the advent of the high back-resistance, quick recovery silicon computer diode all this can be done away with forever and at a price of only $1.58 for the diode (Allied Radio) and a few parts from the junk box. No more heaters to wire, no new sockets or holes to punch. The only change required in the original second dector circuity is to unsolder the lead at the hot end of the volume control (R_5). The limiter is then installed between this lead and the control.

The noise limiter is a typical series-gate type. R_1R^2 form a voltage divider. The tap is at a lower potential than the hot end of R_1. Because of the potential difference between these two points, the anode of the diode is more positive than the cathode and conduction takes place within the diode. The audio passes through the diode and out to the amplifier section. A noise peak of higher amplitude than the modulation peaks will drive the anode negative in respect to the cathode, since a rapid change in voltage at the cathode is prohibited by the large time constant of R_3C_1. At the point where the anode becomes negative, conduction in the diode ceases and no audio is passed on to the following stages. Because the period in which the

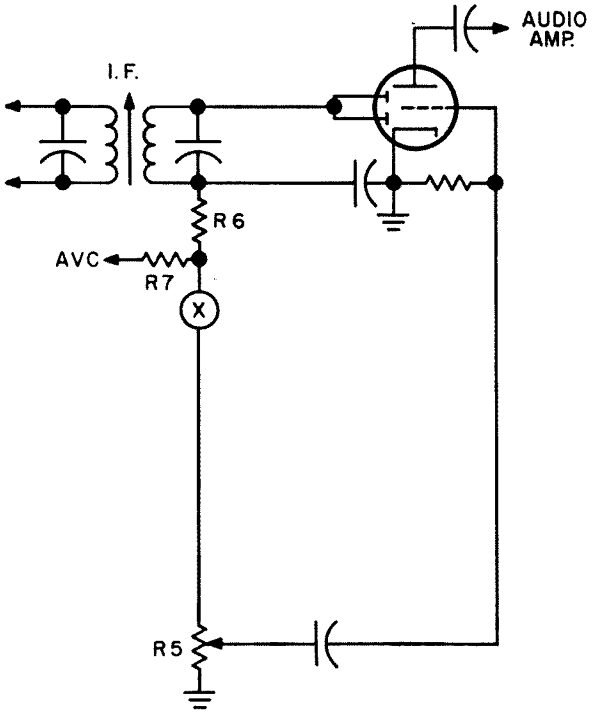

FIGURE 1A

The circuit of the second detector of the average automobile broadcast receiver. X denotes the point where the circuit is broken.

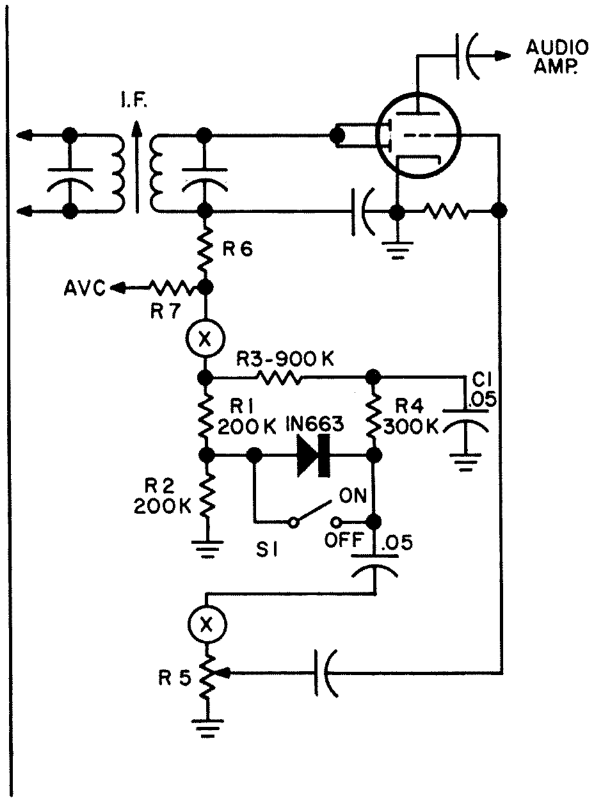

FIGURE 1B

Fig. 1B shows the same second detection with the limiter inserted at this point.

diode is not conducting is very short, the listener does not hear these holes in the audio signal.

For those who are perfectionists, R_1 and R_4 may be adjusted until the maximum amount of limiting and the minimum distortion are found. The values of the components are not very critical, though only a high back-resistance computer diode should be used. Several types of diodes were tried. The 1N663 silicon diode gave the best account of itself while germanium types were almost worthless. If S_1 is located some distance from the limiter it would be wise to shield the leads. One unit is presently in use in a transistorized receiver, the only difference is that smaller values are used in the voltage divider, although this might not be necessary. As shown, the limiter is designed for a negative audio voltage. For a positive voltage, as encountered in some transistorized receivers or from an infinite-impedance detector, simply reverse the polarity of the diode.

The limiter outperformed most vacuum tube diode limiters previously encountered, but like all units of this type, it causes some distortion and is best turned off when listening to broadcast stations.

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Amateur Radio Operating: FCC Version—

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Not many radio amateurs are familiar with the FCC Rules and Regulation affecting the Amateur Service. Rules make dry reading. If read at all, it usually is during a frantic cram for an examination. Quickly "learned," quickly forgotten. The purpose of this article is to discuss these regulations in everyday amateur language. It is hoped the discussion will decrease the number of unintentional violations.

As a starter, let's see what the FCC says about just what *is* the purpose of amateur radio. There's no better way to get this information than from a direct quotation. Here's what Paragraph 97.0, Basis and Purpose, says:

> The rules and regulations in this part are designed to provide an amateur radio service having a fundamental purpose as expressed in the following principles:
>
> (a) Recognition and enhancement of the value of the amateur service to the public as a voluntary non-commercial communication service, particularly with respect to providing emergency communications.
>
> (b) Continuation and extension of the amateur's proven ability to contribute to the advancement of the radio art.
>
> (c) Encouragement and improvement of the amateur radio service through rules which provide for advancing skills in both the communication and technical phases of the art.
>
> (d) Expansion of the existing reservoir within the amateur service of trained operators, technicians, and electronic experts.
>
> (e) Continuation and extension of the amateur's unique ability to enhance international good will.

Say, you didn't realize the lawmakers thought you were such an important person, did you? Now that you know, can you honestly say you've been living up to such a high standard? Look those paragraphs over again, reading carefully. Do you see anything in them pertaining to yap-yapping across town about how much beer you can drink or some other non-technical subject? Do they lead you to believe the FCC thinks highly of the "plug-in appliance" type of amateur? Looking at the other side of the coin; doesn't it make you believe the FCC has in mind the type of amateur who can handle message traffic in a standardized, efficient manner? An amateur who can diagnose, locate, and repair trouble appearing in a piece of communications equipment? Who can contribute new circuits or new methods of applying circuits that advance the state of the art? Who can communicate with a foreign amateur in a fashion that will "leave a good taste in his mouth" . . . . . will create a feeling of friendliness toward W/K amateurs and nationals?

Let's go on a bit farther and see what the FCC says about portable and mobile amateur stations. Paragraph 97.4 says:

> The term "amateur portable station" means an amateur station that is so constructed that it may conveniently be moved about from place to place for communication, but which is not operated while in motion.

You should also note that Paragraph 97.93 goes into a definition of non-portable stations that are operated at other than their regular locations. It states that when operated under these conditions, portable identifications shall be employed. Note the distinction: One is

truly portable, the other is not portable but uses the portable identification procedure.

Paragraph 97.5 defines a mobile station in this manner:

> The term "amateur mobile station" means an amateur station that is so constructed that it may conveniently be transferred to or from a mobile unit or from one such unit to another, and is ordinarily used while such mobile unit is in motion.

That tells a rather definite story. You'll note that there was *no* mention of "fixed portable," "fixed mobile," or "mobile in motion."

Now let's go tearing over to Paragraph 97.83 and see what the FCC has to say about call signs. Let's first talk about "portable" and "mobile" call signs. If you're on CW, here's the way the FCC says you must transmit your call if you're operating portable and calling another station . . . . . whether that station is fixed, portable, or mobile: W1ABC W1ABC W1ABC DE W2DEF/3 W2DEF/3 W2DEF/3 $\overline{\text{AR}}$. That AR, with the bar over it, in case you've forgotten, in ditdahditdahdit, the International Signal for "end of message," which is used at the end of a call before two-way communication has been established. The next example given by the FCC is to show how a fixed station answers the call of a mobile station: W2DEF W2DEF W2DEF DE W1-ABC K. Note three things about this example: No "/3" was transmitted; the calling station does *not* make use of the portable designator, only the station that actually is portable does this. The station responding to the call gave his call only *once;* no need to send it the three times used in the other instances. The responding station ended his call with K, indicating that two-way communication had been established and that the called station was to go ahead.

If you're operating portable and using voice, the basic procedure is the same . . . . . but with one important difference: You *must* give the *geographical location* of your station. Note that again. It didn't say "portable 3" or anything like that. Here's the example the FCC gives:

> W1ABC W1ABC WIABC this is (or from) W2DEF W2DEF W2DEF operating portable 3 miles north of Bethesda, Maryland, over.

There are several things you should carefully note about this example. Note that there are only two legal ways of calling on phone. You may give the call of the station being called, say "this is," and then give your call. Or you may give the call of the station being called, say "from," and then give your call. All other ways are illegal. Note also that the location was given only once, not after each call-letter transmission, as on CW. And, finally, note that the ending signal was "over." It was *not* "go" or any other faddish wording.

For mobile, the CW procedure is the same as that for portable operation. On phone, the only difference is the substitution of "mobile" for "portable" in the foregoing example.

Aeronautical or Maritime mobile has a few more requirements. In the first place, you should note that Paragraph 97.82 (2) (e) plainly states that Maritime mobile operation is that on the high seas . . . . . not on an inland lake or on coastal waters. Aeronautical mobile is defined as that "aboard an aircraft enroute on an international flight." That rules out flights between points in the United States. In such instances, you're just plain mobile . . . . in an aircraft.

The significant differences between Maritime mobile and ordinary mobile is that on CW you use "/MM" instead of a call area designator and at the end of each transmission you must give the name (or number) of the vessel and its geographical location. For phone, you say "this is (or from) maritime mobile WIABC." Of course, you must give the name (or number) of the vessel and its location at the end of transmission, too.

It is much the same with Aeronautical mobile, the differences being that you use the designator "/AM" on CW and say "this is (or from) aeronautical mobile WIABC" on phone. In each case, you must give the number of the aircraft and its geographical location at the end of transmission.

If you're planning either Maritime or Aeronautical mobile operation, it's a good idea to read the regulations in detail. For instance, not all amateur frequencies are available for such operation. Those that *are* available vary with location. Another requirement is that the amateur station equipment must be wholly independent of the vessel's or the aircraft's equipment . . . . . and must cause no interference to the vessel's or aircraft's equipment.

What about your license? There are only two legal places it may be (if it is not being sent back to the FCC for some sort of action): On your person or displayed in a conspicuous place in the room occupied by the operator. A photocopy of the station license may be made and used, but there's no need to make a copy of your operator license. Any sort of copy of an operator license is just so much scrap paper in the eyes of the FCC.

Now to take up license examinations. One of the favorite alibis of holders of Technician

Class licenses, upon failure to pass the written portion of the General Class license examination, is that the General is stiffer than the Technician. Not true; it's exactly the same (Elements 2 and 3(B) in each case). It just seems tougher when you don't have a "buddy" at hand to help you look up the answers in the License Manual!

Do you know how the FCC classifies the International Morse Code tests? It's quite enlightening. They define them in these terms:

Element 1(A): *Beginner's code test.* Code test at five words per minute.

Element 1(B): *General code test.* Code test at thirteen words per minute.

Element 1(C): *Expert's code test.* Code test at twenty words per minute.

That's the only recognition a holder of an Extra Class license gets: He's officially recognized as an expert. This classification should help to settle some arguments as to whether the FCC considers holders of Technicians Class licenses as beginners or as journeymen. This shows that they are classified as *beginners.*

Paragraph 97.45 has some interesting aspects. It plainly states that holders of any class of license, the examination for which was not administered by a FCC representative, may be called in at any time to take an examination before a Field Engineer. If the license holder flunks the examination, his "mail order" license is cancelled, and he may not apply for another of that grade. Tsk, Tsk. Do you suppose the FCC really believes that some "mail order" licenses may have been obtained by perjury? Perhaps the fact that failures on "mail order" examinations run practically zero percent . . . . . and failures on FCC-administered examinations run over 60 percent may have some slight bearing on the unholy suspicions held by the FCC.

The subject of "one-way" transmissions seems to cause some confusion among amateurs. It shouldn't. Paragraph 97.106 tells the four legal types: Emergency communications or drills for such, information bulletins of interest to amateurs, round-table or net-type operations, and code practice.

Paragraph 97.113 may cause some burning hearts among the devotees of nets. It says: "Transmissions by an amateur may be on any frequency within any authorized amateur band." So take it with a grain of salt the next time some Net Control Station threatens to sic' the FCC on you just because you happened to be operating on what he thought was his exclusive frequency!

Logs are a much-debated subject. There are about as many opinions about how a log

should be kept as there are individual amateurs. Paragraph 97.136 sets down a few guidelines. Such things as the date and time of each transmission, the call sign of a station being called, the input power to the final stage (some modification of this on grounded-grid stages) of the transmitter, the frequency *band,* the type of emission used, and the location of the station are the commonly-understood items that give very little trouble. Where the trouble shows up is in the matter of log entries when some third party uses your station. What then? Well, if he had the proper grade of license and operates your station, have him sign the log. The FCC doesn't spell out how this must be done in amateur stations. It would be well, though, to follow the practice designated for commercial stations: Have him sign his signature on a line across the body of the log (not at one side). Have him use his legal signature, just as it appears on his license. Just to be safe, have him add his call. Have him sign "on duty" and "off duty."

What about the non-licensed person who talks over your radiotelephone station? Here's what the FCC says: . . . . . "the name of any person not holding an amateur operator license who directly or by recording transmits by voice over a radiotelephone transmitter or operates a teleprinter keying a radiotelegraph transmitter" . . . . . must be entered on the log. So if you run a phone patch, be sure you get the legal name of the person whose voice goes out over your station. If you leave the mic open and the af gain turned high when you're throwing a beer party in your shack, you'd better hire a sober shorthand expert to keep log! And don't forget that if you run back a recording to show the other chap how good (or how rotten) his signal sounds, you must log *his* legal name, too.

Most amateurs know that they are required to keep their logs on hand for one year, but do you know you're also required to preserve a copy of each message handled (received or transmitted) for one year?

That about brings us to the end of the less-understood aspects of the law. Of course, all amateurs are aware of the law against transmitting profanity or obscenity, the law against transmitting unidentified signals, and the law against causing willful interference. If you have any doubt concerning what is lawful and what is prohibited, purchase from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., a copy of Volume VI, Rules and Regulations. Read it. It may save your license!

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HOW TO DESIGN PHASE-SHIFT NETWORKS

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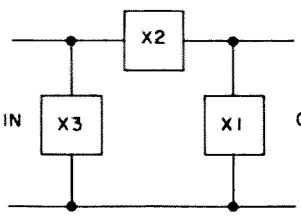


FIG. 1

Contrary to popular belief, design of a phase-shift or an impedance-matching network is one of the simplest matters in electronics!

Of course, if you try to do it with all the mathematics and formulas, you run the risk of getting tangled up in equations so deep you'll never get out—but all of that isn't necessary.

Because a "graphical design" technique exists which makes the whole thing as simple as drawing six lines on a sheet of paper, then solving three problems in long division.

Before showing just how it's done, though, let's see what we're going to do. In "graphical design" we use the length of lines to respresent voltages or currents; if you've ever drawn a load line on a tube characteristic chart you've been using the principles of graphical design.

To keep things simple, we'll consider only the type of network usually called a pi-network in this article. An almost identical technique is used for T-networks, however, and if you're interested we'll describe it at a later time.

In a pi-network, we have three impedances arranged as shown in Fig. 1. The impedances are shown as blocks labelled merely XI, X2, and X3 because at this point we do not know for certain which are inductors and which are capacitors.

Before we can begin the design, we must know a few facts about what we want to do. We can either specify the input and output impedances together with the required phase shift through the network, or we can specify reactances looking into and out of the network together with phase shift.

The phase shift specification, however, is important—because without it, an infinite number of solutions are possible.

Once we know the characteristics of the network we want, we're ready to proceed with the graphical design. It's much simpler if you use polar plot paper such as K&E No. 359-31, available through any engineering supply house, but you can get by with ordinary paper, pencil, and a protractor.

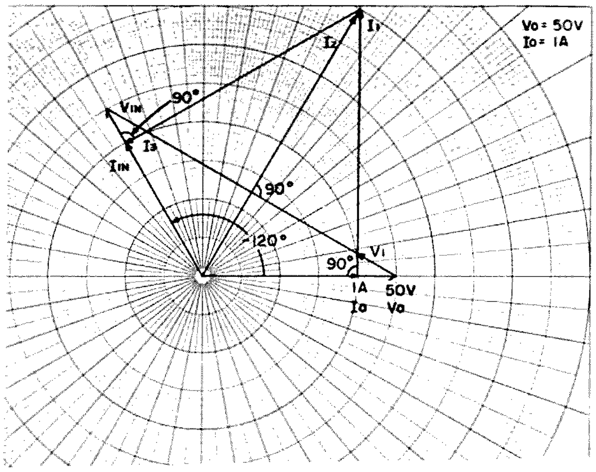
Start by drawing a horizontal line representing the output circuit. If you use polar-plot paper, run the line along the zero-degree radial, from the origin outwards. Assume an arbitrary voltage across the load, and by Ohm's Law calculate the current which would flow with this voltage. Using any convenient scale, measure off a length corresponding to the voltage from the origin along your line, and mark it Vo. Measure another length representing current, and mark this Io.

Next, lay off an angle at the origin which corresponds to your desired amount of phase shift. Draw a second line at this angle, meeting the first at the origin point, and again determine a voltage-current ratio which equals the desired input impedance. Scale off voltage and current, and mark them Vin and Iin respectively.

At this stage, connect Vin and Vo with a straight line. Erect a line perpendicular to the Io line and meeting it at Io, and a second line perpendicular to Iin. Draw a third line from the intersection of these two back to the origin.

Mark the Vin-Vo line as VI. The line perpendicular to Io is II, that perpendicular to Iin is I3, and the one from their intersection to the origin is I2.

Now, measure all the lines and scale them back to voltage and current values. Plug the



voltage and current values into the following three equations:

XI = Vo/I1, answer is in ohms of capacative reactance.

X2 = V1/I2, answer is in ohms of inductive reactance.

X3 = Vin/I3. Answer may be either inductive or capacative.

If I3 line meets Vin from the right, looking outward along Vin line from the origin point, answer is in ohms of capacitive reactance. If I3 meets from the left, answer is in ohms of inductive reactance. I3 may be parallel with Vin, in which case X3 is infinite and the pi-net reduces to an L network.

At this point, things may be a bit confusing, so let's try it out on a specific problem. Let's assume we want a network to shift the phase of a signal by − 120 degrees, with 50 ohms input impedance and a 50 ohm load.

Fig. 2 shows the drawing for this problem. The 50 ohm load has been converted to a ratio of 50 volts and 1 amp, with each major division of the polar-plot paper representing either 10 volts or ¼ amp.

After all the lines are drawn and Vin, I1, I2, and I3 scaled back to volts and amperes, we find that VI = 86.5 volts while I1 and I3 both equal 1.72 amps and I2 = 2 amps.

Then XI = 50/1.72 or 29.07 ohms capacative; X2 = 86.5/2 or 43.25 ohms inductive, and X3 = XI because Vo = Vin and I3 = I1.

Aside from normal accuracy requirements, only one precaution need be observed to keep the design obtained through this procedure as accurate as one worked out with a 10 inch slide rule. The power in the load must equal the power at the input; this is to say that Vin × Iin must equal Vo × Io.

Networks such as these are primarily used for antenna phasing in the 3-30 mc region where phasing lines tend to become unwieldy in use; they find secondary application as rf phasing networks in SSB transmitters.

This design procedure is not easily applicable to transmitter tank circuits since phase shift of these circuits is usually not specified. Normal tank circuits have phase shifts between 120 and 165 degrees; the greater the phase shift, the higher the Q of the tank. To use this procedure for tank circuit design, begin with a phase shift of about 140 degrees and determine Q after the design is finished.

The procedure *does* throw some light on why pi-net tank circuits frequently misbehave, especially when used to feed a line having standing waves on it. The graph in Fig. 3 shows the complete range of solutions for a network matching 100 ohms to 500 ohms; note how the impedance of X3 starts as inductive reactance, climbs to infinity, then comes back from infinity as capacitive reactance. If the tank happens to be operating in the region near 70 to 80 degrees phase shift (for this example), a small change in phase shift makes a large change in reactance for X3. It's easy to run out of capacitor, or even hit that "infinity" point, if the feedline happens to be putting some reactance of its own into the act!

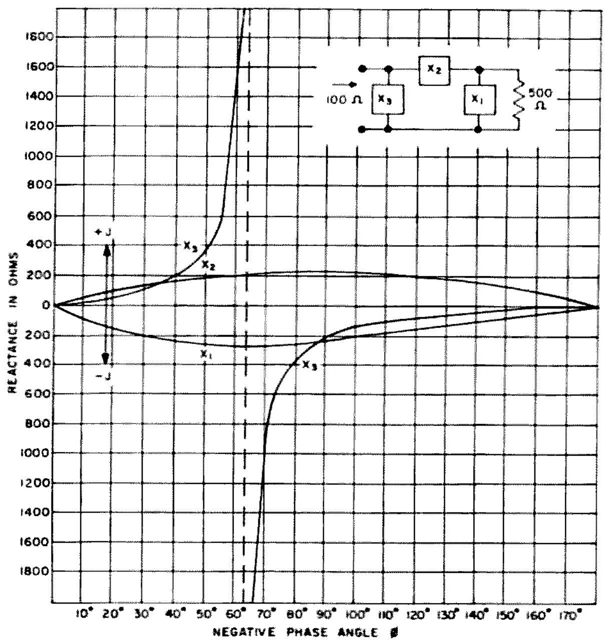


FIG. 3

This procedure, incidentally, was originally described in "Radio Antenna Engineering" by Edmund A. Laport, chief engineer of RCA's International division and a Fellow of the I.R.E., which was published in 1952 by McGraw-Hill Book Company, Inc. Additional details may be found in this book, which can be obtained through Radio Bookshop.

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THE EASY WAY

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Some hams are fortunate, and have towers of either the crank-up or climable varieties on which to hang beam antennas of any conceivable dimension. And then there are the other 95% of us who must make do with pole masts, usually the TV antenna type, and consequently run up against the basic laws of physical science through what I call the 30-degree miseries.

Any experienced 'antenna-putter-upper' can immediately bring to mind vivid recollections of the profanity, damaged bodies and antennas, and just plain frustration that accompanies getting a pole, rotor and beam from the horizontal to the vertical, and particularly at the 30-degrees-above-horizontal stage when Murphy's Law exerts itself with full force.

At the K3LNZ location, there stands a mast (40 feet of it) with a six meter beam (10 foot boom) at the very top and a two meter beam (14 foot boom) at the 30 foot level. This structure was erected in approximately 15 minutes by K3LNZ and one willing 11-year old son. Nothing busted, nobody strained, and profanity was totally unnecessary.

The solution lies in using the scientific approach (otherwise known as the lazy man's way!) rather than brute force, so let's take a look (sitting down, of course) at the nature of the beast we are out to slay. This, as we can see, is simply (?) that at an angle of about 30 degrees we are unable to exert any influence in a useful direction. It's too far up to get underneath and push, except at risk of life and limb, and it's not far enough up to be able to pull. Additional things that want to happen are the bottom of the mast wanting to go up while the top tries to come back down, and the mast itself bending, it not actually breaking, if we apply enough push and pull to make something happen via the classical 'brute force' method. These are the effects, but what is the cause?

There are really two causes, although they interact to some extent so that elimination of one makes it possible to disregard the other. However, a still better way is to eliminate both and either work less and/or put the antenna up higher than usual. Cause No. 1 is the obvious fact that all the weight is at one end of the mast, which just happens to be the wrong end from a mechanical standpoint. Cause No. 2 is that the average pole-type mast will support relatively heavy loads in a vertical position, but does not have the necessary strength to support much weight when tilted. The solution to No. 1 is to reduce topside weight to a bare minimum. The solution to No. 2 is not a stronger mast as this is going back to brute force; it is simply to arrange things so that the mast stays vertical, or nearly so, while putting it up.

Elimination of the topside weight has an obvious solution, as there is only one thing up there that doesn't absolutely have to be there—the rotator. Most rotators weigh more than the mast and antenna combined, and any will support the mast as well as the antenna, so simply put the doggone things down at the bottom and turn the whole mast, antenna and all. The mechanical details are simple, and we will pass them by for the moment and get specific later in the article.

Keeping a mast vertical can also be accomplished more easily than most of us think. Practically any roof has a chimney, sewer vent, skylight, trapdoor, or simply an edge, down which a mast can be dropped while we fasten an antenna and guywires to the top, and then raised up to the desired height. Even if there is absolutely no place to go downward, such as in rocky ground at a field day site, it is still possible to get things situated so that the maximum height at which we have to actually touch the mast with our hands is 10 feet. This will be sufficient to meet our requirements of keeping the mast vertical, or at least nearly enough vertical to avoid any undue strain, so that we can theoretically erect a pole mast of any height whatsoever.

Now for the details. Putting the rotator at the bottom of the mast requires that we find

some means of attaching guy wires to a mast which must turn. For 65c, we can purchase a swiveling guy ring intended for use with TV antenna installations. Although this looks as though it would provide a lot of friction, it works out very well and the first experimental installation using this equipment held up for several months with no difficulties and obviously would have lasted much longer. However, a trip to New York resulted in discovering a ball-bearing guy ring (Crown Co. GR-2) at Harrison Radio for $1.98, so this is what is in use now and it is an unqualified success. Our rotor is an AR-22 (CDR) which is rated for 150 pounds dead load and has no trouble at all with a mere 40 feet of mast and two antennas. Other rotors would require thrust bearings, which are quite cheap, to support the added weight. The mast itself is the top 40 feet of a 50-foot telescoping TV mast. The bottom section wouldn't fit into the rotor, but some day we'll make up an adaptor and raise the antennas another 10 feet. Finally, a loop in the feedline is required to permit the mast to turn without the feedline dragging the guy wires around. Ours is about a foot in diameter at the mid-point of rotation, and will permit things to go 180 degrees in either direction from there with no sweat.

Keeping the mast vertical was accomplished by means of a large packing crate on which K3LNZ stood to reach the top of the telescoped mast at 10 feet above the flat roof. The six meter beam was affixed, then the top 10 feet hoisted into the air and the two meter beam attached. The guys had already been attached, so the next 10 foot section was hoisted away and the 11 year old son then went around and tied off the four guys temporarily while #2 and #3 mast sections were bolted together. Then the son went around in circles loosening each guy while the mast was steadily pushed upward to use up the slack. This involved the top of the mast revolving drunkenly, but only goes to prove my contention that anything even approximately vertical is good enough if you don't get all shook up and try to wrestle it back to exactly vertical. Finally, all 40 feet of mast was standing more or less upright, at which point the guys were slackened still more to permit getting the bottom of the mast about 8 inches off the roof and the rotator inserted underneath and bolted on. Finally, the bottom was positioned exactly where it was wanted and the son stood back criticizing angles while K3LNZ went around making final adjustments to the guys and for the first time in the process getting things exactly vertical.

Now it is impossible, or at least not practical, to put packing crates, stepladders or what have you on sloping roofs, but the foregoing method can still be utilized by using one of several possible variations. A chimney or vent will always provide at least 10 feet of space in a downward direction, if not enough to assemble a whole 40 or 50 feet of mast with the top still at roof level. It is also possible to sit on the peak of the roof at one end of the house, or up on top of a car at a field day site, or just about anywhere at all where you are in no danger of falling, but can still lift the weight (surprisingly little) of mast and antenna. The basic principle is to hoist things up first, and move around to the exact position desired in gradual steps later.

Let's try a sloped roof installation for drill. We'll presume there is a chimney about halfway down one side of the roof, but that it isn't a very deep one. Place the telescoped mast as far down as it will go, and you will find you still can reach the top to bolt on an antenna (and rotator too, if you insist on putting it up there the old fashioned way). Add guy wires and hoist up as far as you dare, then tie down the guys quite loosely. A helper on the ground will come in handy here, but one man can go it alone by using a loop of rope to hold the mast up as high as it has been pulled while he goes down to play with guy wires. Now alternately slacken guys and raise mast, with necessary stops to fasten ten foot sections if necessary, and in a short time you'll find that the antenna is up, and you didn't have to strain or swear to do it. If you didn't want to fasten the bottom on or near the chimney (or whatever you used), simply slacken the guys some more and move the base around until it is where you want it. If this involves going up a sloping roof, a rope to the bottom of the mast passed over the peak and down the other side to be tied will hold things. This will require a helper, to be sure, but even a wife can be trusted to perform this simple function.

Finally, a word on guying. As you may have noticed, we stressed not worrying about guys being too loose during the erection process. This also applies at all times. Just enough to keep the top from really moving around will do the trick and will actually survive sudden gusts of wind better than something that is already as taut as a banjo string. By putting the rotator on the bottom, correspondingly lighter guys can be used anyway. Let me know how your new cloud-scraper works out. . . . K3LNZ

This 1200 v power supply control gives automatic reserve power, prevents shock hazard and uses inexpensive TV components

Simple Automatic Failsafe Power Supply Control

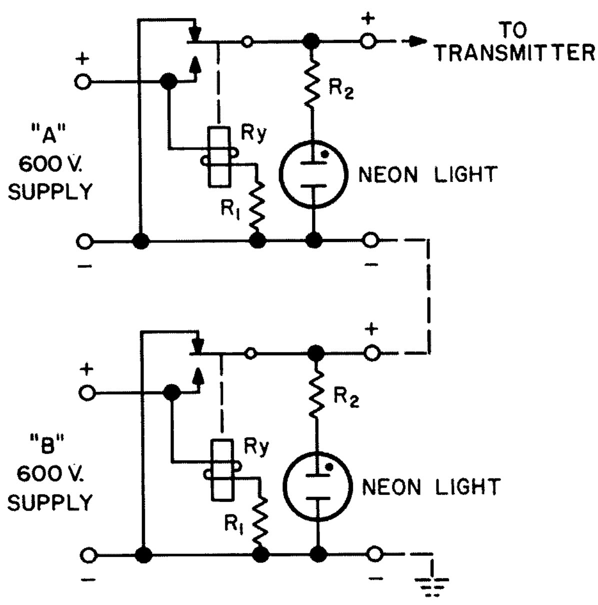
Zoltan Bogar W3CJM
1921 Marymont Road
Silver Spring, Md.

If you are building a high voltage power supply for your transmitter and really want to save money, or if you are going sideband with your transmitter where doubling the rated voltage on the final is the accepted thing, this is just for you.

Instead of using a 1200-volt transformer and using high voltage condensers, build two 600-volt supplies, or if your transmitter already has a 600-volt supply, just build another 600-volt supply and add it on.

If it is already grounded, lift it free from the chassis and tie all negative connections together.

Now use a 24-28 volt spdt surplus relay and connect the coil in series with the bleeder resistor if one is used in the power supply. If the coil resistance of the relay is around 1000 ohms, then a 25,000 ohm 15 watt resistor should produce around 24 volts to operate the relay. Use a relay with good insulation at the contacts. Insulating the relay itself on a piece of phenolic board is also a good idea.



Ry—spdt 24-28 v. surplus relay with 1000 ohm or higher coil.
R1—2400 ohm 15 w. bleeder for 600 v supply and 1000 ohm relay.
R2—1 meg. ½ w. (for 600 v supply).
NL—NE2 neon light.

I built a relay into each power supply, under the chassis, and brought the armature connection of the relay contact to the positive output terminal and the minus lead to the negative terminal post. Of course, the relay can be connected externally just as well.

After the relays are wired up as shown in the diagram, the two power supplies are merely connected up in series. The positive of one goes to the transmitter plate, the negative to the second power supply positive, and the remaining negative is grounded.

A glance at the diagram now will show that, with both power supplies turned off, the transmitter plate is not just disconnected from the power supply, but grounded. No chance of getting a nasty shock from the filters when making any changes on the transmitter. When the power is turned on to the power supplies, the relays energize and both outputs are in series supplying 1200 volts.

One of the most appreciated parts of this simple arrangement is experienced when either power supply fails. Without lifting a finger, the defective supply just drops out of the picture and the remaining one keeps the transmitter in operation. Should this happen during an enjoyable rag chew, DX with a rare QTH or in a contest, the automatic reserve power alone makes the effort of building this arrangement worthwhile.

If you want to go on sideband with your push-pull 6146 AM transmitter and double your power at the same time without making a lot of changes to hurt the resale value, this is just the thing. Remember, if you want 600 volts to go on AM again, all you have to do is just turn off the 120 v. AC to the input of either one of the supplies and you have 600 volts. Just that easy.

Neon lights with sufficient series resistance may be connected up as indicated on drawing, to show which power supply is operating.

. . . W3CJM

Francis Natali K2DXO
44 Garden Road
Cheektowaga, N. Y.

Incremental Tuning for the NCX-3

The wide variety of transceivers that have recently been offered by several manufacturers are certainly a boon to many of us apartment dwellers. The XYL is sure to squeal with delight as the old rock-crusher is rolled out to make room for what looks like an ac-dc radio. Unfortunately, she may make more familiar sounds if she gets a load of the price tag on that little box.

The situation being what it is, most amateurs have to compromise between versatility and price. One of the most popular compromises appears to be the National NCX-3.

The most serious drawback of the NCX-3 and similar medium-priced transceivers is the lack of incremental tuning, that is, being able to tune the receiver a few kc's either side of the transmitter frequency. This is especially true on CW, since the transmitter frequency

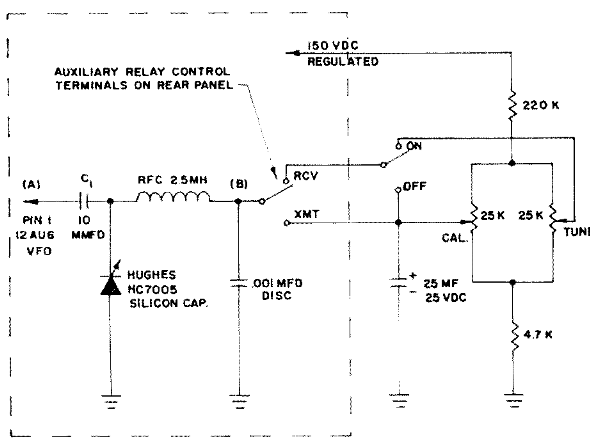


FIG. 1

is approximately 1 kc from the receiver frequency. This leads to a frustrating follow-the-leader game. If a station zero beats your frequency, then he doesn't produce a beat note and you must tune to one side; this changes your transmitter frequency, so when you come back, he sees that he is off frequency and zeroes you again; now when he comes back . . .

Let's consider another situation. There are three guys in a round table, one is a few hundred cycles off frequency. The guy with the transceiver ends up using the frequency of the last station to transmit. This is confusing since not only are the stations on different frequencies, but this guy with the transceiver keeps switching!

It is pretty obvious that incremental tuning has its advantages. Now let's talk about the price of including it in your transceiver. If you buy everything new, the price could run as high as seven dollars. The average junk collector can probably get away with $1.65 for the Hughes varicap.

The incremental tuning circuit is shown in Fig. 1. It can be built and installed in about an hour and completely removed in about 15 minutes. The parts inside the dotted line are mounted on a single terminal strip which can be mounted under one of the bolts near tube socket V5. The end of the Hughes varicap marked with an H should be grounded. Point (a) is tied to pin 1 (the grid) of the vfo tube V5. A wire is run from point (b), along the wire harness to the middle relay terminal on the rear chassis apron. I ran a wire from the OA2 tube to an empty pin on the xtal calibrator octal socket on the rear apron of the chassis and used it as a power plug. The rest of the components can be mounted in a little box. Lead lengths between (a) and (b) should be kept short; all other leads carry only dc and can be any length.

The theory of operation of the circuit is very simple. The varicap acts as a variable capacitor; its capacity depends upon the back bias applied. In the transmit mode, a preset voltage is applied; when in the receive mode, the voltage can be varied to tune the receiver. When the relay switches from the receive to the transmit mode, the 25 mmfd capacitor acts as a very low impedence source to change the varicap bias to the transmit value in a matter of microseconds. Since this frequency change is accomplished in much less than the transmitter rise time capability, no chirp is heard. The tuning range available can be varied by changing C_1.

The parts are not critical; however, care should be taken not to exceed the PIV rating of the varicap if the biasing network is changed.

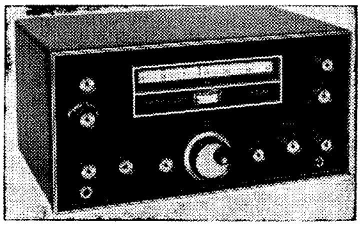
Adjustment and operation are straight forward. With the I.T. switch in the off position, set the *calibrate* control to about mid

scale. Now adjust the vfo trimmer capacitor on each band so that the calibration is correct. Small changes in calibration should hence forth be made with the *calibrate* control. That's all there is to it.

When calling a station, zero beat him with the I. T. switch off. Flip the switch on and do all subsequent receiver tuning with the I.T. control.

This cercuit can be easily applied to transceivers similar to the NCX-3; the details are left to the reader.

. . . K2DXO



HQ-88

This new Hammarlund receiver has been particularly designed for frequency stability and will sit there without a quaver while you beat it or drop it (a short distance). It covers 10 thru 160 meters, MARS, CB, WWV, and the marine bands. Selectivity is 2.2 or 5 kc. There are separate AM and SSB detectors. Price is $299! Sounds like quite a package. Drop a card to Hammarlund, 53 West 23rd Street, New York 10 for info.

Lafayette 1965

Just as we're getting used to writing 1964 out start coming the 1965 catalogs. Lafayette has one of the largest there is, so you'd do well to make sure that you are on their list for it. Lafayette is the major importer for a lot of parts and gadgets that you won't find elsewhere, in addition to carrying all of the popular lines of equipment and parts. Lafayette, Box 10, Dept 73, Syosset, L. I., N. Y. 11791.

OOPs

Corrections to W1OOP article in September 73.

Fig. 1: 2N176 emitter resistor should be one ohm. 2N214 collector load should be 4.7 k.

Fig. 2: Short the terminals labeled "DC open." Eliminate capacitor "add temporarily." Break between emitter and junction beneath emitter. Add temporary capacitor across break.

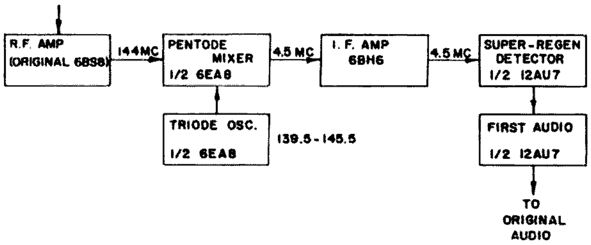
Fig. 5: Oscillator base bias resistor should be 22 k rather than 2.2 k.

Fig. 7: Should be labeled "Optional Squelch Circuit."

The Super Two'er

It was a great man who said, "Everyone talks about the weather, but no one does anything about it." For a long time the receivers in the Heath Two'ers and Six'ers have been in the same category—Enough sensitivity to make everybody talk about them—but poor enough selectivity to make everyone swear at them. Yet no one ever seemed to do anything about them. Now, however, someone has come along and done something about the Two'er.

When Lawrence Engineering announced the modification kit for the Two'er, I was skeptical but anxious. When the kit arrived I was impressed from the beginning. The step-by-step manual runs 31 pages and does everything but tell you what hand to solder with. There are 7 clear, well defined illustrations, including photographs of the unit in its stages of preparation. The illustrations come out of the manual so that they can be referred to separately without the need of flipping pages back and forth as you try to keep your step-by-step place and consult figures at the same time.



The entire modification took me about 9 hours, which includes the tune up. Following the step-by-step procedure is easy —they must have been written with the raw novice in mind. At times, however, I felt they were too simple, that there was too much explanation. Nevertheless, although I've built many a kit, I followed them as if I could do only two things: 1) read, and 2) solder. There was no trouble getting it to purr. If there had been, there are four pages at the end of the manual entitled "Trouble Shooting Guide."

The circuit of the modification is fairly simple and is best given by a block diagram.

Basically the diagram is self explanatory. The old dectector-amplifier is converted to a two stage radio frequency amplifier and a simple heterodyne oscillator and *if* strip and added on a subchassis. This is where the selectivity come from. The superregenerative type detector is retained but only because it performs several functions and so helps the tight space problem. This type of detector is an excellent noise limiter as well as a very sensitive detector eliminating the need of additional *if* stages. Its usual defect, lack of selectivity, is largely eliminated by putting the oscillator and *if* strip ahead of it.

Mechanical assembly of the new subchassis is done first, followed by a few mechanical modifications to the original chassis. Then the old rf amplifier-detector is converted to a cascade (two stages) rf amplifier. This part of the conversion sounds complicated but actually requires only 7 wiring changes and a couple of components which are supplied. The new two-gang tuning capacitor is then mounted and the subchassis dropped into place and given a preliminary tune-up, then a bit more wiring. After a final tune-up, the whole thing is put back into the original case and you're back in business.

To make the conversion you'll need, beside what is provided with the kit, a ¼" drill and reamer (there are a couple of ⅜" holes), a soldering iron and grid dipper. A signal generator could be used for the final tune-up but the grid dipper gets the slugs close enough and an on-the-air signal lets you peak it right on the button.

Operating the unit afterwards is a revelation. The old superregenerative hiss is still there so it still sounds like your old Two'er —but that first signal you tune causes an almost traumatic experience—your eyes and ears tell you that it's a Two'er you're tuning, but your mind tells you it can't be—it's too sharp.

On the debit side of the ledger is the superregen hiss and lack of vernier tuning. I for one, however, agree with the introduction in the manual which says you can't beat the old superregen for simplicity, noise limiting action, and what's more important, sensitivity. The superregen detector now operates fixed at 4.5 mc and is isolated from the antenna by several stages so that there is no receiver radiation whatever. Tuning is still direct drive but the boys at Lawrence Engineering tell me there just wasn't room to use a vernier mechanism on the capacitor they felt was needed to do a top job. Furthermore the vernier would have increased the price of the kit $5 to $7. If you wanted to add your own

I'm sure it could be done, outboard, at the expense of looks.

Stability in both mobile and fixed-station use has been very good. I've enjoyed first telling a contact that I'm using a Two'er and then a transmission or so later telling him, within a few tenths of a per cent or so, what his frequency is. It leads to some interesting contacts. Selectivity is quite adequate so that even with W1GB (a kw monster) operating a few miles away, I can work other signals as close as 15 kc without any difficulty. Try that without the modification. Sensitivity is definitely improved by the two stages of rf amplification and signals that used to be down in the mud are now readable. A big plus for net operation is that lack of receiver radiation. Where the net used to be squiggles and squeals, now you're not sure there is anyone on—until they transmit. Then they're where they should be, and only there.

The kit is sold by Lawrence Engineering, 36 Lawrence Road in Hamden, Connecticut, for $29.50 with tubes.

LE calls the kit 2NT6301 but everyone locally refers to it as the "Super-Tow'er" and it is! . . . K1TVD

2B and HO-10

Jack Browne W6TTD

I recently purchased a new Heath HO-10 Monitor Scope and upon connecting it to my Drake 2B Receiver was a little disappointed with the results.

Though the Scope was connected to the last *if* stage as prescribed in the Heath Manual, the height of the envelope pattern displayed on the Scope was only ¾" and was not ample to give an honest analysis of the waveform.

After consulting Drake, plus considerable experimentation, I connected the scope to the plate (pin 7) of the AVC amplifier and detector tube V6 and immediately the Scope pattern filled the screen and was easily controlled by the Vertical Gain knob on the Scope's front panel.

No retuning is necessary, nor is there any deterioration in the operation of the Drake 2B I used a coupling capacitor of 12 mmfd, which falls within the specified range of 5-15 mmfd suggested by Heath.

This little Scope has since proved a most versatile piece of station equipment for all modes of operation.

. . . W6TTD

Our Man in Washington and an Appraisal of our Amateur Radio Position

Wells Chapin W2DUD
118 Woodmancy Lane
Fayetteville, N. Y.

A man in Washington is important and rather obvious when we find that all other associations have full staffs and building locations in Washington. The whole problem of holding our present amateur band and status is much more basic than just a man in Washington. Let's get right to the point. The present international aspects of amateur radio demand that we do all the things necessary to protect our very important and useful hobby. This is the time for serious appraisal of our Amateur Radio position. Our 40 meter band is seriously threatened. We are in a blue chip poker game where the stakes are the portions of the spectrum we use and these are worth billions of dollars—yes, you read right, billions of dollars. So let's be professional in our approach to holding onto them. Let's ask ourselves the searching questions that any good businessman would ask if he were trying to hold onto this very valuable natural resource. For instance: have we lost or gained prestige and bands? Do we have a written plan based on the future considering that we will grow—the population of the world will grow—and there will be a general increased demand on our spectrum by ourselves and others. What are the projected figures of our numbers by the 70's and 80's? Should we start our counter-action and demands now? What should they be? A name is important—does the name Institute of Amateur Radio or ARRL better describe our activities?

Now if you are satisfied that all is well, then relax and let our bands be continually nibbled away. If you are interested in protecting amateur radio then read on—and we will discuss a few of the issues.

Everyone resists change. Corporations that have resisted change have died. Let's look at this problem with an open mind. The ARRL has done a lot of good things for amateur radio and unquestionably will do more. However, many years have passed! Have we examined the structure of ARRL to see that it is in tune with the times? Perhaps it is, but we must be sure. The ARRL has had some wonderful assists by many men who have given time and money to preserving our hobby. To name a few—Reinartz, Schnell, Sterling, Maxim, Hebert, Herbert Hoover, Sr., and our present President Herbert Hoover, Jr., Mathews, Tuska and hundreds of others. The writer has had the pleasure of knowing many of the fine men—and believe me, fellows, we are here today because of the work of these men and the ARRL.

Now let's take a look at a few of the issues and enlarge on them.

Have we lost or gained bands? Facts are facts. We used to have amateurs on 32 meters, 33, 34, 36, our bands in those days was 37.5 to 42 meters, and then on an international basis we started in again at 43, 44, etc. In addition, we had other bands. Browsing through the IFRB (International Frequency Registration Book) we find more than 5,000, repeat 5,000 registrations between 7,000 and 7,300 KC—so it's no wonder we have intruders in our bands—they are there legally agreed to by international treaty signed by our government. Now go to your local radio store and pick up the 1964 Edition of the World Radio and TV Handbook. It is about 33% larger than two years ago. Turn to page 245 if you use the 80 meter band. If you operate 40 like I do and you bless the foreign broadcast—turn to pages 252 and 253. Browse through this book—it is interesting reading and a good deal cheaper than the hundred dollars for the four volumes with the fourth volume in 4 parts of the IFRB. Yes, gentlemen, we have been like Rip Van Amateur Winkle and we are awakening from a long sleep and find intruders in the bands—and bands missing that we had before our sleep. Also, one finds after careful reading of the 1962 ITU (International Telecommunication Union) activities report that amateur radio does not get a single mention and as a matter of fact you cannot find the word amateur mentioned in the report.

Let's go to the next point. What numbers of amateurs will be around in the USA and internationally in the 70's and 80's? Quot-

ing 200 Meters and down, in 1910 there were 90 amateurs listed in the Wireless Blue Book. So that you are not bored with a lot of statistics, we will quickly jump to 1958 where we find in the FCC record that there were 185,000 Amateurs, the FCC record of 1959 lists 195,776, the FCC record of 1960 lists 217,000, the FCC record of 1961 lists 222,170, and the record of 1962 lists 237,159. The Spring call book of 1964 lists 268,113 US and 111,304 foreign. Thus, it looks like our average growth rate has stabilized to about 13,000 additions per year. Now if this growth continues, in 1980 we will have at least 500,000 Amateurs all crowded into the same space or less unless we act now. However, with the citizens-banders getting interested in Amateur Radio perhaps the average per year will accelerate at a more rapid pace—perhaps to as many as 600,000 by 1980. Guess I'll buy some stock in the amateur radio equipment manufacturing business and get lined up with QST, and 73 as they will have plenty of potential readers—or should I—will we survive?

We know that the projected population of the world shows substantial growth and of course, this means that foreign Amateur radio will grow along with commercial and military interest thus creating additional further demands on the spectrum. Short wave broadcasting will grow because we are in a world wide market and economy and the world will need this medium to tell their story. Take a look at the radios on store counters—many have short wave bands hereas as little as two years ago you found these only in amateur radio type receivers. Who would ever think we would hear our favorite cereal and soft drink advertised on shortwaves—but you can now. Just listen to and around the forty meter band—or should I have said in the 40 meter band? Have you heard our VOA broadcasts from Africa in the 40 meter band? This is legal too, by international agreement our country has agreed, to the ITU international zone that Africa is a part of, must use this amateur band for broadcast purposes. Another fact should awaken us to the fast growing use of the rf spectrum is that to keep up with its work of registration of world wide frequencies the IFRB has installed computers. Just recently the FCC announced the first computer issued license for amateur radio. Growth? Should it worry us? Enough said!

Do we need planning? Planning in the commercial world is a full time job. Our allocation problem is extremely complex and has other intricate political tie-ins in the USA and world wide. Psychological problems are also tied into it. Certainly, it is mandatory that a team of men be doing nothing but planning and working for our survival and have no other duties IE: such as publishing a magazine along with P&L responsibility. We should now be in the process of researching all the aspects of the problem including our public image, projected increase of amateurs, population of the world increase and its affect on future allocations etc., etc., etc., etc. Nothing much has been mentioned about national and international military demands that are now based quite heavily on electronics. Plans realistically look at where you have been—where you are and where you want to go and most important how you are going to get there. You don't go from New York to Chicago without a road map and knowledge of the problem. You don't fiddle around when billions of dollars are at stake or where you know that there is just so much of this resource with many countries wanting it and then there just "ain't no more" when this runs out. Good planning will anticipate the demands of intruders on our allocation and what we will do to counter. Plans include minute things such as who will buttonhole what individual from what country and what will he say, etc. This work should be done right now—by men who do not have a magazine to publish and keep in tip top shape. We should have operating right now, many committees, of the best brains in amateur radio planning various aspects of our attack and defense. Yes, planning is very, very important. Perhaps it can start with a team in Washington with cooperation from all sources.

In our appraisal of where we stand another issue should be discussed. Should an association and a magazine be one and the same?

We find a very fine successful association (which incidentally is headquartered in Washington) that is comparable to our amateur radio situation: IE they use spectrum and have similar problems of diverse groups within the association having different goals, etc. We find that this association has a very large very competent and complete staff headed by a very important influential, prominent, and very competent individual much like our present President Herbert Hoover, Jr. This non-profit group has a full staff whose sole job is to support and perpetuate their industry. The magazine that covers the news and activities of the association, and is of general interest to the association members, is entirely independent and has its own set of officers and P&L statement. This magazine has been at times, quite critical of some of the activities of the association and some of its members and has done a really fine job of reporting and is of great general worth to the group they serve.

It is not healthy to have an association print its own magazine. Many times there must be conflicting interests in arriving at editorial policy, advertising policy and what is good for the association. When you are the publisher it is difficult to be critical of your own work. Hi. That old Biblical quote is so true "You cannot serve two masters."

What's in a name? While this is a side issue—it could be an important one. You constantly project who you are, what you are, by your name. We just cannot afford to miss a single thing. Every day in our electronic business we find large companies merging and changing their names. They always pick the most descriptive appropriate and meaningful name. One well-known oil company very recently, and still is, in the process of changing its name. If they can and do change their name—so can we if we feel it would gain us something. Does ARRL or IOAR fit us or should it be some other name? Our name is a front to those who do not know us. What sort of image do we want to project? Ask any Amateur of the world what ARRL is and he immediately recognizes it. However, where we are hurting, our image to the general public of the world, you would find many people who would not know what ARRL was. Heaven forbid I've tread on sacred ground on this one and I'm sure the Hartford Radio Club members in the Ham Shack in the sky are already sending an SOS. Hi. Those men who carefully picked an appropriate name in 1910 would really be unhappy—or would they? Maybe their love for ham radio would have surmounted even this obstacle. Well—anyhow—let's not cloud the main issue with this one—but consider it along with all the rest of the issues. Know the ARRL, work with the ARRL, know your director, work with IOAR. These are trying times. We need all the help we can get. Time is rapidly running out. We must act now.

As you have probably guessed—our job is not an easy one. A separate Amateur Radio Organization takes funds and will not come easy. You don't have a magazine to support it—the bucks must come from your pocket and mine. I've already anted up my $10 to IOAR, have you, and will you? Let's have as our slogan—What will you do for amateur radio—not—what will amateur radio do for you.

. . . W2DUD

Letter

Dear Wayne,

Occasionally in my rummaging for information I come across something that is useful to other people.

If any hams are looking for azimuthal maps, there are a variety available from the U. S. Navy. The following are the chart numbers and the center point and price:

5199A	San Francisco, Cal.	$.30
6700	Fairbanks, Alaska	.40
6701	Seattle, Wash	.40
6702	Honolulu, Hawaii	.40
6703	Guam, Marianas	.40
6705	Washington, D. C.	.50
6706	Moscow, U.S.S.R.	.40
6707	Adak, Alaska	.40
6708	Kodiak, Alaska	.70
6711	San Diego, Cal.	.40

The above should be ordered from the Hydrographic Office, U. S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia 20, Pa., if you live east of the Mississippi. If you live west of the Mississippi order from the U. S. Navy Hydrographic Distribution Office, Clearfield Annex, Odgen, Utah.

There is also one centered on New York City, but this must be ordered from the U. S. Coast & Geodetic Survey, U. S. Dept. of Commerce, Washington 25, D. C. Specify chart 3042 and enclose $.40.

While none of these have the amateur prefixes that are on the ARRL map, they should prove invaluable to anyone near the mentioned centers who is trying to align a beam.

John McDermott
Stratford, Conn.

Myron Pogue W6VAX

SB-33 and MP-10

So you are planning on buying one of the new transceivers! After complete evaluation of the available models (see "73" magazine for April), I chose the Sideband Engineers model SB-33. Everyone's reasons are usually quite personal for their choice of a transceiver —mine included:

1. I didn't want to give up 15 meters.
2. I liked the lower priced units as a personal investment.
3. I liked the small package with a built-in ac power supply and speaker—good portable rig.
4. I liked the idea of mostly transistors for reliability, less heat, low level handling of rf and inherent stability.
5. I wanted selectivity—2.1 kc mechanical filter was just right.
6. Easy conversion to mobile by an ac inverter appealed to me (here is where my story really begins).

So I traded for an SB-33 Transceiver!

At the home station with a beam antenna for 15 and 20 and a trap inverted V antenna for 40 and 75, the transceiver met my fondest expectations. I even worked out barefooted on 20 meters on weekends reasonably well.

There was one small awakening, however, I tried several microphones which were not recommended, only to receive reports of questionable or poor audio quality. Ceramic mikes won't work even acceptably on the SB-33. Most dynamic mikes represent a sufficient mismatch so as to provide less than the desired audio quality. Finally, I purchased the recommended Turner model SR 90-D with an impedance of 25,000 ohms and, Eureka!

I have also tried various antennas on the rig. The receiver is very responsive with a resonant antenna for the band being used. The latitude of impedance matching of the transmitter seems limited but is adequate for resonant antennas with an impedance in the 50 ohm to 75 ohm range.With appropriate antennas, it is a great transceiver.

So far, the special Inverter provided by the manufacturer had not been available in my area. Being impatient to try the rig as a mobile, I ordered the Heathkit Model MP-10. The ratings of the Heathkit Marine Inverter are more than ample. It is rated at 175 watts continuous power output with 12 volt input, while the SB-33 requires only 165 watts for rated PEP of 135 watts input. The SB-33 works on the MP-10 Inverter, but two things were readily apparent. First, there was a terrific 120 cycle hum in the receiver. The Heath Instruction book states this will happen and provides a solution: put 1 or 2 mmfd 200 volt capacitors (non polarized) across the ac output of the inverter. Two 1-mmfd capacitors reduce the hum to an acceptable level.

Next, the power input and output of the SB-33 using the MP-10 was only about ½ of that from the self-contained ac power supply when connected to the power lines. This comes about because the voltage tripler in the high voltage supply looks at the peak value of the power line voltage, or 166 volts rather than the 117 RMS. What to do? I finally decided to take the transformer of the MP-10 apart. After removing the laminated core, it was apparent that I could add one layer of wire and connect it in series with the output winding to provide the required higher voltage. Experimentation proved that one layer (about 75 turns) of no. 24 enamel wire provided the desired voltage and would fit the space in the window of the transformer after first removing the outer covering and using brown paper sprayed with Krylon for insulation between layers.

The original output of the Inverter is connected to pins 1 and 4 of the SB-33 socket on the rear of the transceiver. The new winding on the MP-10 is connected in phase to ad voltage by connecting from pin 4 to pin 5. This, of course, is actually done inside the MP-10, and I replaced one of the ac receptacles with an octal socket and wired to the same pin numbers as on the 11 pin socket on the SB-33. Now I can operate with full power as a mobile using my modified Heath MP-10 Inverter. I'm not sure I would go to this trouble again if the special Inverter were available. However, the Heathkit Inverter costs about half as much as the special Inverter and the modification is quite easy to make. The result is gratifying and on the air I can tell about rewinding a transformer to make my transceiver mobile. . . . W6VAX

KØCER

The Amplidyne 621

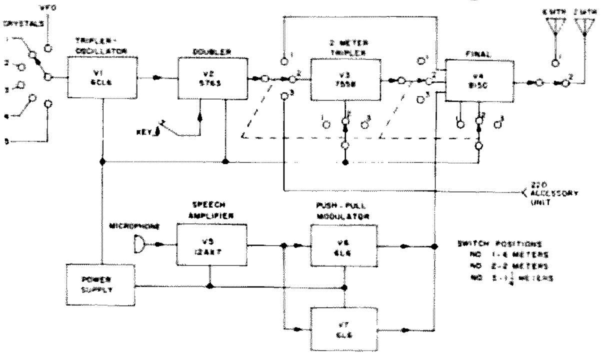
In the past several years, the Technician license plus decreasing solar activity has given VHF quite a shot in the arm.

To keep pace, manufacturers have become more competitive in the VHF field, offering many fine pieces of gear from Nuvistor converters to complete SSB rigs.

One of the new rigs on the market is the Amplidyne 621, a complete AM/CW rig for six and two meters with external accessories for 220 megacycle operation. The rig, measuring 8″ × 14″ × 10″, is manufactured by Amplidyne Labs in Kings Park, New York and sells for $274.50.

The new Compactron final, an 8150, is rated at 60 watts input with an output of 40 watts on both six and two. A check with a wattmeter bears this out. This is accomplished through the use of separate link coupled tank circuits for each band with individual SO-239 antenna connectors.

Modulation is excellent according to both



local and skip reports . . . and it should be. The rig is 100% modulated with a pair of 6L6's. With this rig the fellow on the other end won't have to strain his ears to hear audio on a 30 over nine carrier, a fault that is common on the VHF bands.

W6AJF says the best modulator is a key. Amplidyne has not overlooked this.

They have actually built a VHF rig with a key jack! And the CW note is excellent. Keying is done in the 5763 doubler stage and is chirp and click free, real T9X quality with crystals (I do not own a VFO).

The only feature that I don't care for in the CW end of the 621 is that the oscillator/tripler, a 6CL6, runs continuously and I don't like to hear it when I'm pounding brass . . . but that's a small price to pay for a fine note.

One thing I'll never figure out is why VHF manufacturers won't add CW when they are designing a rig. Technicians should be able to take 5 wpm and many of them can. If you don't believe that CW is up and coming on six meters then you haven't tuned below 50.1 during openings.

On one recent opening the CW band here in South Dakota sounded like the low end of 40. Remember, CW has a 16 to 20 db gain over AM . . . and that's a lot.

The fused power supply is solid state using silicon diodes to provide dc for the B-plus and bias. It is built on a separate subassembly, making any necessary repairs easy.

The oscillator is a 6CL6 with tuned plate and will accept 6, 8 and 12 megacycles crystals in FT-243 holders or an external vfo. One external and four internal crystal sockets are provided; selection is made with a front panel switch.

A 5763 is used in the doubler stage. Here the output of the oscillator-tripler is doubled, the bandswitching achieved and the rig keyed. On 50 megacycles, the doubler is tuned to six to drive the final, and on 144 megacycles, the doubler drives a 7558 tripler which feeds the final.

The tripler is not used for six meter operation.

For 220 megacycle operation, only the oscillator is used and voltages to the other rf stages are disconnected. Modulation and power for the (Amplidyne 221) 220 megacycle adaptor is taken from a BNC connector on the rear of the chassis.

A spotting and tune-up button on the front panel is convenient. It is used when tuning the oscillator, doubler and tripler stages, and

for checking your frequency before firing up.

Along these lines, Amplidyne has come up with a built-in 50 ohm dummy load. With this, the operator can tune-up without putting a signal on the air and little touch-up should be needed when the antenna is connected . . . if it is matched. I've noticed that the link coupled tank circuit doesn't take kindly to an SWR of more than 2 to 1 and full loading is impossible. The SWR should be better than this anyway and it would seem Amplidyne may force some antenna systems to be cleaned up.

The dummy load is selectable from the front panel and a flashing red light tells the operator when the dummy load is switched into the circuit.

The entire rig is well metered with a large, easy-to-read Honeywell meter. The meter reads oscillator, doubler, tripler, final, modulation and relative rf output with a six position ceramic rotary switch. The 621 uses ceramic switches and sockets throughout.

So far, I've been using the 621 with a ground plane antenna and have been working most everything I can hear, but, of course, a beam will be in use by the time you read this. Those 40 watts of CW and 100% modulated rf "do make a hole" even with the ground plane.

No trouble has been encountered, and I don't really expect any with this fine little rig.

. . . KØCER

Wayne,

Enclosed please find a photo of what is left of a six meter halo antenna after going through an automatic car wash while the attendant was reassuring me that it would fit with no trouble.

Ed Bratek, K8VPH
Whitmore Lake, Michigan

Return to the Art and . . . ! !

DL4VQ, ex-AFA3DSQ
Dan Davis, K3DSQ

Over three years ago I was forced to "disinterest" myself from amateur radio for—as I had thought at the time—a rather brief period. I had enlisted in the Air Force and concluded that I would get back on the air as soon as I had completed basic training and become settled on my first permanent base. I was fortunate enough to receive an assigment to a top rate electronic tech school at Denver, Colorado, but this proved to be unfortunate insofar as amateur radio was concerned. I learned soon enough that barracks life is not always conductive to firing-up therig at weird hours of the night. Twelve months later I found my self on my way to Germany, and amateur radio was, most assuredly, the least of my concerns.

During the twenty-four months I have been stationed in Germany the thought of assembling a station and getting back on the air has occurred many, many times. However, military or other duties have always precluded my doing so—until recently. A change in my duty assignment afforded me the opportunity I needed. I applied for, paid for, and received my German license and call letters. At the present time I'm waiting for the arrival of some equipment from the States. During this interim period I've been avidly catching-up on the latest changes and innovations that have affected amateur radio during my absence from the air. Recently, I picked-up a copy of *73* and read an editorial that had an effect on my constitution identical to that of accidentally coming into contact with the "wrong side of ground." I am, of course, referring to the recent announcement of the ARRL stating that it would no longer represent the interests of American amateurs.

What's happened? Frankly, I am rather confused by this turn of events. Confused, disgusted and frightened would, perhaps, be a better description. My own interest in amateur radio dates back nigh unto ten years ago when I can remember trying to tune in old super-regenerative, sitting in a cold, dimly-lit attic. It was then when I also became aware of the ARRL's existence and its mission. I formulated my own opinion of the League and concluded that it had to be a fine organization to represent the amateurs' interests to the FFC. As the years went by, I became more convinced of my findings and became almost fanatical in my devotion to the boys in West Hartford. To me, the League could certainly do no wrong, and anyone who was not a member, was simply "not with the program." I had become a member of the League long before I obtained my Novice ticket and gladly went through the annual ritual of paying my membership dues. If I looked forward to one particular day of the month, it invariably had to be the day I received my copy of *QST*. On one occasion I even had my photo appear in the magazine, thereby increasing my support of the magazine and the League! I had become as pro-ARRL as it was humanly possible. So, imagine my surprise when I read W2NSD's editorial.

Seriously, what actually has happened and what will happen as a result of the League's policy announcement? I, for one, feel as though I've been taken for a ride by the ARRL. A small ride, perhaps, but nevertheless, a ride. After all has been said and done, it now becomes very apparent that I had not been receiving everything I had paid for—most of all, "protection from" and representation to the Great White Fathers. This could be construed as the disgusting element in this case. At most, however, I think I could accuse the League of dishonesty in this particular instance (offhand, I know of no others). I am certain there are many others who must feel the same as I, and I'm sure there are still others who will disagree with me.

Perhaps you think I'm knocking the League too hard, and maybe I am. Looking back over the record, we must honestly admit that the League has done "beaucoup" good for amateur radio. There can be no denying this. If it hadn't been for Mr. Maxim and his group in the post-WWI period, I would now have no reason for even writing this article. What about the League sponsored Amateur Radio Emergency Corps? Then, there's always the code practice from W1AW. The ARRL had represented our interests in an admirable manner and had certainly created a favorable overall impression of the typical amateur. The League has, however, dropped the ball in an extremely vital and important area, and this should be of concern to all of us—VHFer, DXer, RTTYer or the plain ragchewer.

Let's now view the situation in a realistic manner from a fresh and different angle. What is the present value of membership in the ARRL? The value is probably similar to that of belonging to the RCC or DXCC—a certificate and nothing more. Of course, we must not forget *QST*. I have always felt and still do feel that a subscription to *QST* is definitely deserving of my hard-earned money. And I certainly intend to renew my subscription. But what about the protection and representation that had formerly been associated with the subscription? Obviously, this is a new era. So, where does this now leave us? Allow your imagination to run wild somewhat and suppose that a proposal is made by the FCC that would only remotely affect the amateur servvice. How many of us would take it upon ourselves to write Washington (since we are now devoid of representation there) either yeaing or naying it? I'd venture to say very few of us. And those who would take the time and effort would be analogous to the "voice crying out in the wilderness." Unless the proposal were extremely grave in nature, I'd probably keep pen in pocket and mouth shut. But what would develop if a series of seemingly "minor" proposals were enacted and all linked together? Might this not seriously affect that which we hold so dear to heart? No matter how naive one might be, he must admit that this possibility does exist. I am not taking the stand nor even implying that the FCC is out to get us and forever rid itself of the amateur service, but through ignorance on their part and inattention or silence on ours, it is possible for regulations to be enacted that could have a detrimental effect on amateur radio. Without backing from a representative group we would probably never muster sufficient strength to make our feelings clear to the FCC. We could very well be presented with a "faite accompli."

Basically then, what we now need is an organization that can pick up what the ARRL has dropped—protection and representation. Our need can be expressed in the statement "Protection *by* Representation." Be it the Institute of Amateur Radio, an organization fostered by *CQ* or another magazine, or even the RCC, but let us have some group represent us in Washington! "United we stand, divided we fall"—this old cliché could never hold more truth as far as we are concerned. The present state of affairs, if allowed to continue, could develop into what will in the future be called "The Boys' Period of Laissez Faire," the period when they could have saved amateur radio, but instead lost it. . . . K3DSQ

Kenneth L. Mills K8AJD
3013 Cameron Street
Kalamazoo, Michigan

Heath Application Series

Many hams like myself are not electronic engineers. We have become hams because we enjoy the fascination and the challenges it offers. But to be honest, we have to admit that we have obtained a rather sketchy background in the theory and knowledge of electronics. We can make basic measurements and tests. But when it comes to really getting the most out of our rigs and test gear, when it comes down to solid knowledge of its operation, our limited background and training becomes painfully evident. Speaking from personal experience, the ham who does try to up-grade his electronic education often finds himself going in several erratic directions at the same time.

Correspondence courses are one answer. But often the house payments and shoes for the junior operators don't leave much for final amplifiers and beams, much less home study plans. The Heath Company has an answer for the ham who would really like to know more about electronics and test equipment. As usual, the price is reasonable.

The Heath Company has produced a "Heath Application Series" which is based around three most useful pieces of electronic gear, the VTVM, signal generator, and oscilloscope. The manuals are well written. Along with the pictorials they are easy to understand. The experiments are clearly and well illustrated. Purchase of the test instruments is optional as most hams have some of these pieces of equipment. If you don't have any of this gear, try first for the VTVM and its course. Second get the signal generator and its course. These two alone will be of immense help to you at once. Later on the oscilloscope makes a good addition to your bench.

Each manual starts with very basic concepts and leads you via study up to a very sound level of electronic know-how. In addition you will have gained the knowledge to enable you to get the utmost out of your test gear.

You do more than just read—you experiment too. Furnished with the VTVM manual is a small transformer operated power supply. This unit is just as easy to assemble as it is useful. I have mine out on the bench all the time for use as a source of variable low power ac and dc. It could easily be modified for a gem of a bias supply.

In addition to the study of ac and dc current flow, Ohm's law, voltage dividers, and plenty more, the VTVM series really teaches you how to operate and understand the VTVM. It is really surprising to know about the many things a VTVM will (and will not) do. If you don't have a VTVM, get one with this manual. No ham can live without one.

When you get the signal generator course, you get in addition to a very comprehensive manual, a uniquely designed test chassis complete with a 150 μa meter, speed clips, transistors, and components used in performing experiments. Heath also offers either a rf signal generator or an af signal generator to go along with the manual if you so desire. The purchase of a signal generator is optional as with the other kits and manuals.

The signal generator course again starts with basic electronics, but very soon gets into a study of oscillators, amplifiers, modulators and signal generator operation. One note about

the experiments. They are made easily and quickly. After initially soldering speed clips to the components, you can put the soldering gun on the shelf. No more soldering or unnecessary work is required. It is no trick at all to convert from a modulated transistor rf oscillator to a multivibrator or to a simple receiver or any of the many other experiments covered in the course. After studying this course you can use the knowledge gained not only in your hamming, but you can probably start servicing some of the neighbors radios and pay for the course. As a side note, the experimental chassis is just the answer for experimenting with solid state devices such as silicon controlled rectifiers, diode devices, etc. Mine has seen lots of use.

The third part of this course deals with the status symbol of the ham shack, the oscilloscope. Most hams have been using the scope for monitoring purposes—and not getting full value for this versatile piece of gear. This course does a good job of explaining the scope, its circuitry and its operation. This knowledge can make your scope a real asset to your test bench as well as your ham shack. In this course as in the others, you study test equipment maintenance and trouble-shooting. You can keep your ham gear in good shape without a scope. But with a good scope and a good knowledge of its operation, you will do a better job of maintaining your station and have more time left for operating the rig. Also, this course shows how you can keep the frau's hi-fi in tip-top condition. (You remember the hi-fi set that you had to buy for her when you got the transceiver.) The scope also includes another experimental chassis which really makes the breadboard look ancient. The unit is complete with all transistors, speed clips and parts used in the experiments. If you don't have a scope and can't buy the little lady a hi-fi set to go along with said scope, get the manual and experimental unit just the same. Sooner or later the knowledge is going to get you out of a jam.

When all is added up, it is hard to see how a ham can afford to stay ignorant when Heath has put out such a good study-experiment course at such a reasonable price. Your time and study investment will be small in comparison to the cost of a new rig, the embarrassment of a pink ticket, and in general the enjoyment of ham radio that sound knowledge can bring. You won't become an electronic engineer, but you will be way ahead of the local ham who asked me what kind of an "oscillating" scope he should buy.

. . . K8AJD

(Stuff from page 4)

Approximately 90% of ARRL funds being spent on the publishing business

Rubber stamp Directors meetings

I've probably omitted some important items from the list; these just came immediately to mind. All of these problems . . . and those as yet unborn or uncovered . . . can be cured if *you* care enough to speak up. These are not problems of differences of opinion, they are mostly abuses of power and they reflect on all of us for permitting them to happen and to continue. Let's push hard for honesty and integrity and try to get back to where we are the captains of our own fate.

Remember . . . we are extremely fortunate to have some excellent hams running the amateur section of the FCC . . . fellows who seem to be doing better for us than our own League. But these chaps are not selected by us and if we should suddenly find new men antagonistic to ham radio later replacing our friends we would have little recourse since we have already turned our fates over to them. If we can regain control of our hobby through our representative organization we will stand a far better chance of having a secure future. I think we can do this by working to improve the Institute and the League and by speaking up loudly and clearly when something shady

or shabby happens to us.

You can get information on the problems we face by reading 73, The Monitor (Box 4133, Sta. A, Dallas, Texas 75208, send for sample), and K6BX Xtra Newsletters (Box 385, Bonita, Calif., send 50c for sample).

The Institute of Amateur Radio needs your support ($10 year) in its program to lobby in Washington for amateur radio and help amateurs with legal ham problems. The Institute is the *only* amateur radio organization registered to lobby for our hobby. The Institute is the only national amateur group providing direct financial support to amateurs fighting legal battles that can affect us all. Support the Institute.

CB Delay

The new CB regs have been held up from the November first deadline until thirty days after the FCC has a chance to act on petitions submitted by several groups and manufacturers. I note that S-9 magazine is still encouraging CB'ers to ham it up, in spite of the coming regs.

Tower Case

The Mace Warner WØJRQ case was postponed until January 26th when Andy Bohley KØOOA, the Engineer in Charge of the FCC office, a key witness, died suddenly on the day of the trial. Andy had been with the FCC for twenty years and was well known for going out of his way to help local amateurs.

K6BX Quits CQ

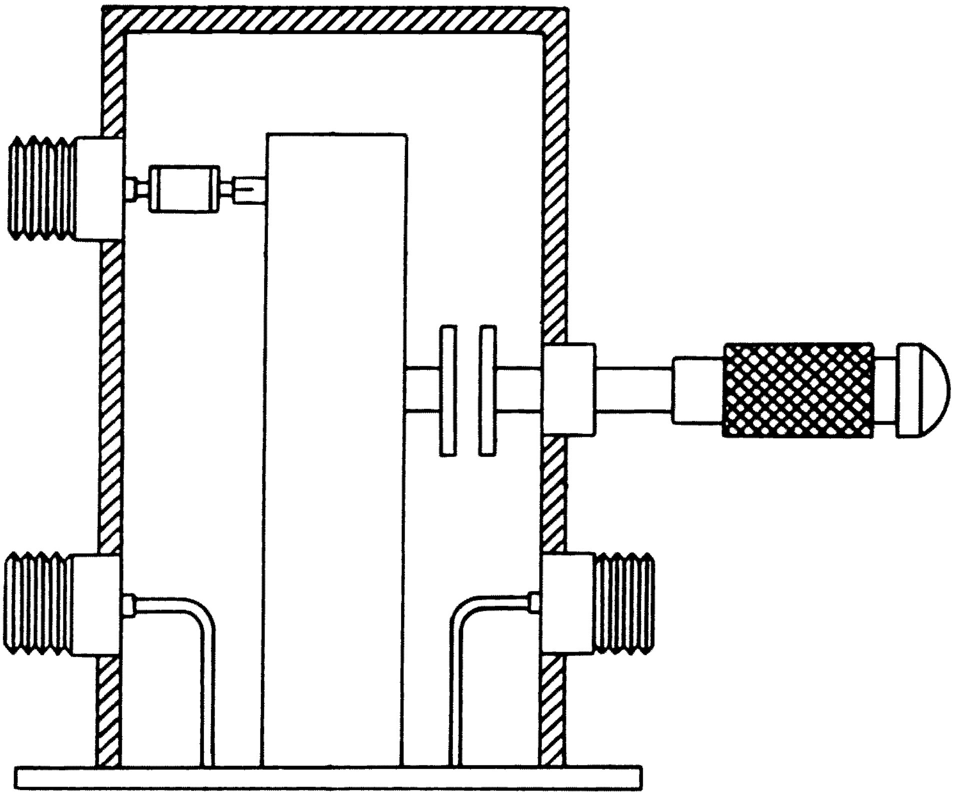
Clift's Xtra News Letter #19 just arrived. It's worth every bit of the $2.00 a year he charges. In this issues he goes into details about his association with CQ and his problems in getting paid, along with his final blowup and revulsion with their way of doing business. Hey Clif, how about a club for all us ex-CQ staffers? Anyone that is interested in much of the behind-the-scenes maneuvering in our hobby would do well to subscribe: Box 385, Bonita, California.

Clubs!

Please make sure that 73 is on the mailing list for your bulletin, or, if you don't have a bulletin, that we have an address for your club. We send out information bulletins every now and then to clubs . . . information that you cannot get elsewhere. Plus other benefits which we can't mention here.

Say, I could use a couple 417A's if anyone has some spares. Also I'm looking for a 416B and a 4CX1000.

. . . W2NSD/1



PARAMETRIC AMPLIFIERS

by Jim Fisk WA6BSO

A New Book Published by 73

This book, the first on parametric amplifiers for the ham, is written for the average amateur and explains in simple language how they work, how ot build your own for the various UHF bands, and how to tune them up. Parametrics have helped UHF move into the space age, but don't forget that the first working parametric amplifier was built by W1FZJ and worked on six meters.

Order this book direct from Radio Bookshop, $2.00 postpaid, on from your local parts distributor.

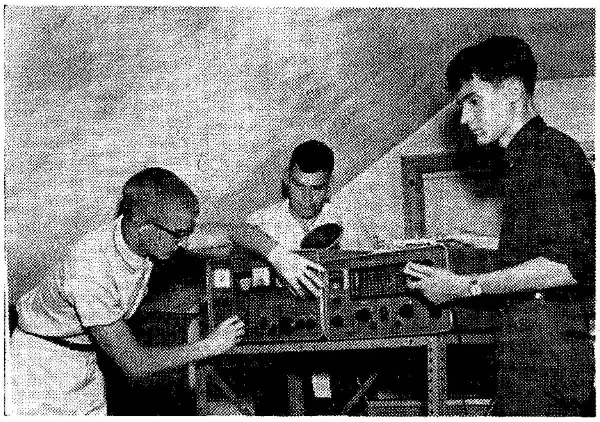
RADIO BOOKSHOP PETERBOROUGH NEW HAMPSHIRE

Kentucky DXpedition

Hammarlund pulled a new one this time, one that just may give them some future trouble. The Hammarlund DXpedition Of The Month is pretty well known now, particularly to the DX hound population of our hobby. Well, Stu Meyer W2GHK, president of Hammarlund, set up a rare county DXpedition which racked up over 1500 contacts during a three week tour of the backlands of Kentucky, Virginia and West Virginia.

Arthur Shahan Jr. K8YOM was DXpedition master while Alan Day K8ITH and Paul Keller Jr. K8EJN did the work. The station wagon, equipped with an HX-50 transmitter, an HQ-170 receiver, a linear and a trap dipole for 80-40-20 meters was supplied by Hammarlund. Since there obviously would be many spots where ac was not available an Antenna Specialists Zeus generator was included. Camping and cooking gear eliminated the need to find a friendly motel . . . a fortunate precaution, for few such places were found.

The original plan was to visit 20 hamless counties, but the three weeks alotted to the



trip was over before all were reached, so only 16 were actually activated. The back country of Kentucky was a lot harder going than anticipated.

The DXpedition started in Columbus, Ohio on August 11th with the first stop being Olive Hill in Carter County, Kentucky. Time ran out in Pocahontas County, West Virginia on September 2nd. Seldom did they find a combination of sleeping quarters and an antenna site, so many of the nights were spent sleeping on the ground or in the station wagon with the mosquitoes, flies, and thousands of nameless but weird insects hungrily gnawing at every exposed inch of flesh. Meals were sometimes cooked, sometimes eaten out of a can . . . and frequently ptomaine was chanced at local eateries. Beans . . . ecchl

Motels in this area were tried a few times, but most of them didn't have a lot to offer over the bare ground. At least out in the middle of a field you don't have to fight off enormous spiders and lizards who are indignant at your presence in their room. You do have to admit, as they advance, that they've been there a lot longer than you and have seniority.

Campsites seemed even more acceptable after the experience with a motel in the Kentucky mountains. The motel owner was away so permission was gotten from his daughter, who was in charge, for the antenna to be put up. When the owner and his wife returned the wife got frightened that spies or revenuers had moved in and hysterically screamed for her husband to throw them out. He threw himself into the situation and soon was running around threatening to break the equipment if things didn't get packed up immediately. Tempers were held, even when the owner kicked Paul in the slats.

Kentucky. Roadsigns riddled with bullet holes . . . half the houses deserted . . . that motel. In Owsley County a judge was asked for permission to hang the antenna from the court house steeple. After glancing at the letter of introduction from Hammarlund he asked that it be read to him. Finally he grumbled, "Ah dunno anythin' 'bout these thangs. Y'all come back tomorrow and ah'll find somebody knows somethin' 'bout it."

One setup was in a small building on a tobacco and pig farm. Unwashed children begging for candy, teenage girls and an old drunk who fell all over the feedlines slowed down operations. The shack set up in a combination kitchen-bathroom will not ever be forgotten either. Honest.

Either in spite of or because of the difficulties everyone had a fine time. It is just possible that Hammarlund might back another DXpedition of the Month like this some day, so be on the watch for it.

The logs for the trip are still on hand, so if you haven't QSL'd yet, send your card to DXpedition of the Month, G. P. O. Box 7388, New York 1, N. Y.

We Need Your Help

You can help ham radio as well as us by encouraging friends to subscribe to 73 or giving a gift subscription or two. The more hams that read 73 the more that may take an interest in the preservation of our hobby . . . the more that may be intrigued by the large number of construction articles and start building.

1st Gift Subscription	**$4.00**	
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3rd Gift Subscription	**$3.00**	**(yours?)**

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Separate paper may be used for your subscription if you are hesistant about shredding your copy of 73.

CLUBS: Five or more subscriptions sent in at once are $3.50 each for one year, $6.50 for two years. Club secretaries should send for our Special Christmas Club Offer. . . . It is worth the effort.

Letters

Dear Wayne,

Last May I was able to visit the World's Fair for half a day. I made a bee-line for the Coca-Coca pavilion. After a long wait I was able to enter. Before very long I found myself back in the sunlight with a strange craving for a Coke and no sign of K2US. Finally my myopic eyes lighted on that little door. I went up the stairs, sure that I was where I shouldn't be, when suddenly, near the restrooms, I found it. I went in and was greeted rather coldly. I will not say that the man on duty was rude, but he did look at me as if I was three-legged. After reluctantly being permitted to operate I left a short piece of traffic addressed to my parents at home. It is now August, that piece of traffic has yet arrive, and I have lost what faith I had in the National Traffic Handling system.

Charles S. Peavis K6PVS
Alexandria, Indiana

Dear Wayne,

May I request that you print some information on the origins of WA2USA and its brief existence. Many local amateurs are aware that there was another station at the Fair besides K2US, but few know much about it.

Several weeks ago I had the sad experience of representing the Radio Club of Brooklyn for one whole day at K2US. I departed late that night for Brooklyn, very depressed and tired. Wayne, no one has been able to tell me why K2US even exists, except that it is run by HARC. Can you tell us why this station was ever brought into existance, who did it, and what they thought they would accomplish with the setup?

Lew Levitt WB2NDI
Brooklyn, N. Y.

Well, Lew, some of the facts are hard to come by, but here is the story as I know it: It was generally agreed that there should be a ham station at the World's Fair. The reasoning behind this was that with all those millions of people visiting the Fair this would be wonderful publicity for ham radio. At the suggestion of W8OLJ the ARRL got together with Coca-Cola and a big ham station was planned as a feature of the Coca-Cola exhibit. Everything was going just fine when word leaked out that HQ had decided that only equipment of one single manufacturer would be on exhibit. No explanation for this decision has ever been released, a fact which has led many amateurs to suspect the worst. When word of this reached Coca-Cola they were furious. The next thing we heard was that the man who made the agreement with the League for Coca-Cola had been fired and that instead of having the feature spot in the pavilion, K2US had been moved up into the attic where virtually no one except hams would ever see it. Several of the manufacturers who had been frozen out of this exhibit decided that this was too much and within a few days arrangements had been made for a ham station to be a feature of the not yet completed Venezuelan Pavilion. The prestige of the Pan American Radio Club, made up largely of amateurs who could speak Spanish, helped to convince Venezuela to donate this valuable space. The club obtained the call WA2USA and had their station on the air in time for President Johnson's official opening of the Pavilion on May 9th. It is estimated that over $50,000 was spent on this station!

Back at K2US ther was trouble. The League finally admitted sponsorship of the station when Coca-Cola gave them an ultimatum to either sponsor it or take it out. Running of the station had been turned over to the Hudson Amateur Radio Council, the local ARRL satellite.

Though it may have been coincidental, you'll never convince one of the WA2USA ops that the interference from K2US was anything other than intentional. After a couple days of this nonsense they put in a receiver a couple miles away with a phone line and solved the problem, much to the consternation of the K2US group.

The ARRL was not taking this calmly. They'd been made the fools and they knew it. They went to work on Venezuelan officials, on the FCC, and on a couple unhappy Pan American Club members. At length a loophole for stopping the station was discovered. A fault was found with the station application which forced the FCC to cancel the license until it was corrected. By the time the license had been straightened out enough Venezuelan officials had been pressured to prevent the station from getting back on the air.

It is doubtful if WA2USA will return to the air except under ARRL domination. A lot of very sad hams have found that they couldn't fight the Hoover name and a multi-million dollar publishing corporation.

References: Myers-Coca-Cola letters, Bulletin #4 and WA2USA White Paper by W2AOE, Bulletin #53. Both available at no charge from 73. SASE please.

Dear Sirs:

Recently, I visted K2US at the Worlds Fair, and I believe I saw there one of the worst representations of Ham Radio I have ever witnessed. I am not going to speak of the location or equipment, but only of the attitude of those present.

From the start, I was made to feel about as welcome as a participant in an 11 meter ragchew. Those present seemed bored with the whole idea and I was told in no uncertain terms "Our main purpose is not to entertain visitors, but to handle traffic." In short, the entire atmosphere was less than cordial.

Up to now, every single Ham I have ever met has been the nicest most helpful sort of person you could hope to see but those at K2US showed an attitude found only in the CB band.

I was almost ready to become a member, but if this attitude is representative of how the ARRL feels toward K2US, I regretfully say I want no part of your organization!

Craig E. Buck, WN4TUF

Dear Wayne,

Three mailorder companies advertize 2N1907 high power transistors for about $2.00.

Since this is the only large unit available designed for RF service, I bought 6 of them (2 from each source), and tested them both in transistor tester, and in actual service: as a 4mc oscillator and amplifier. Results:

4 units—defective on a tester (short, open, etc.)

2 units—about 20% output compared with a known good transistor.

All units came evidently from the same source—Texas Instrument—and are of no use to hams.

Most of the outfits replaced them with different merchandize.

Gus K6BIJ

Hi O.M.,

On page 24 of the March 1964 issue, in the text accompanying circuit board illustration, instructions are given to remove resist with thinner or gasoline. Well, the purpose of this qsl is to stress that gasoline should *never* be used as a solvent, cleansing agent, or thinner—in the home or home workshop. It's simply too dangerous to be trusted and besides, modern leaded gasolines are very toxic to the skin.

My objection is based on the assumption that any ham radio construction work will be done indoors. Gasoline doesn't belong indoors, no matter how careful one may be. Agreed?

W6DMB

Boom!

Report from D. K. Lovett K8BXT in "Q-Match," the bulletin of the Warren (Ohio) Amateur Radio Association.

73 Magazine has been the target of much criticism regarding lack of facts, statements based upon "unfounded rumors," etc. CQ and QST have been strangely quiet about Wayne Green's expose of K2US, the amateur radio

station located in the Coca-Cola pavilion at the New York Worlds Fair. I had the opportunity(?) to observe the K2US setup at the Worlds Fair and I can report from actual experience that much of what Wayne Green says about K2US is true and that QST in two articles, one in April 1964 and the other in August 1964, misrepresents the facts, in many instances, regarding K2US. The vast majority of QST readers will not get the opportunity to visit the worlds fair perhaps and therefore would not be able to expose the inaccurate reporting on K2US as publishd in QST.

It is a shame that amateur radio is not properly represented at the Worlds Fair. The station K2US, contrary to QST reports, is out of the way, in relative obscurity, and would be easily passed by if one were not specifically trying to locate an amateur radio station in the Coca-Cola pavilion. The station is not at all a typical amateur radio station—rather a showplace for Hallicrafter products. This alone is a great injustice to the many quality amateur gear manufacturers all across the country, many of whom would probably have welcomed an opportunity to contribute toward the equipment in the station. You could find a more representative station at most any field-day site or at most hamfests.

The station is operated by club members from member clubs of the Hudson Amateur Radio Council and certain guests. The group operating the station during my visit were from the Rockaway Amateur Radio Club. The group on duty were in general aloof and unfriendly. Only one operator, W2YBU, talked to me or offered any semblance of hospitality. He heeded my rattling on the locked door at the station room.

I was allowed to come into the station and look around. I located a register and "signed in." After several minutes, W2YBU mentioned that I would have been able to operate if I had brought my Amateur Radio operators license. He was quite surprised when I told him that, in fact, I had brougrt my license with me and would like to operate one of the rigs in the station. I produced my license, in a frame, which W2YBU very carefully examined. He checked the license for my signature, looked for the US Government Printing Office number on the license edge (this does not necessarily have to be on the license if the license edge has been trimmed as directed on the license) looked on the back (the last two checks were made after removal from the frame—done at his request). It was obvious to me that he was trying to find something out of order with the license. Unable to do so, he exclaimed, "Well, I guess its your license all right." I emphatically informed him that it was. W2YBU informed me that I might be able to operate in 20 or 30 minutes. I noticed that the 75 meter station that had not been in use for several minutes suddenly had an operator again. The two meter stations was in trouble, as assigned operator could not load up the two meter gear and the 20 meter SSB station was in constant use for DX contacts by W2EVV. It appeared to me that they were not at all interested in allowing me to operate.

I am surprised at the tone of the K2US progress(?) report in August 1964 QST. Again, they misrepresent facts, and would lead one to believe that all but 900 who visited the station did not care to operate or were "content" to watch the activity. The article does not state the number of the 900 who are members of the member clubs of the Hudson Amateur Radio Council or whether the 900 were all different operators. The August QST report was a good opportunity to correct the many inaccuracies in the first QST report but they failed to do so. Some reports are being circulated that the station had been moved from a spot that fits the April 1964 QST description. No mention is made of this in the August issue however. I wonder how many amateurs missed the station from the inaccurate description they may have read in QST.

In my opinion, K2US has done little to enhance the amateur radio image in either the eyes of the public or in the eyes of radio amateurs.

To keep the record clear—I did not operate at Amateur Radio Station K2US. After what I had seen and heard regarding the operating bit, I promptly excused myself and left K2US to the Hudson Amateur Radio Council and, thoroughly disgusted, continued to see the Worlds Fair.

Rebel

Col. David Danser W4GVQ was presented with the "Confederate States Amateur Radio Club "Distinguished Service Award for his outstanding devotion and leadership in the advancement of amateur radio communication at a joint meeting of the club with the Fort Belvoir Amateur Radio Club.

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7#	14	14	14	14
ARGENTINA	7*	7#	7#	7	7	7	14	21	21	21	21*	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7#	14	14	14	21	14*
CANAL ZONE	7	7	7	7	7	7	14	21	21*	21	21	14
ENGLAND	7	7	7	7	7	7#	14	14*	14*	14	7#	7
HAWAII	14	7#	7	7	7	7	7	7#	14	21	21	14
INDIA	7	7	7#	7#	7#	7#	14	14	7*	7#	7#	7
JAPAN	14	7#	7#	7#	7	7	7	7	7#	7#	7#	14
MEXICO	7*	7	7	7	7	7	7	14	21	21	21	14
PHILIPPINES	7#	7#	7#	7#	7#	7	7	7*	7#	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	14	14*	14*	14	14	14
SOUTH AFRICA	7#	7#	7	7#	7#	14	14	21	21	21	14	14
U. S. S. R.	7	7	7	3.5*	7	7#	14	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	7	14	21	21	14

Good: 4-8, 14-22
Fair: 1, 2, 3, 9, 10, 11
Poor: 1-3, 9-11
Es: 12-13, 23-30
(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

ALASKA	14	7*	7	7	7	7	7	7	14	14	14*	14
ARGENTINA	7*	7#	7#	7#	7	7	14	21	21	21	21*	14
AUSTRALIA	14*	14	7#	7#	7#	7#	7#	14	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	14	21	21	21*	21*	14
ENGLAND	7	7	7	7	7	7	7#	14	14*	14	7#	7#
HAWAII	14	14	7	7	7	7	7	7	14	21	21	21
INDIA	7	7	7#	7#	7#	7#	7#	14	7*	7#	7#	7
JAPAN	14	14	7#	7#	7	7	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	14	14	14*	14*	14
PHILIPPINES	14	14	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	14	21	21	21	21	14
SOUTH AFRICA	7#	7	7	7#	7#	7#	14	21	21	21	21	14
U. S. S. R.	7	7	7	3.5*	7	7	7#	14	7*	7#	7#	7#

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	7	14	14*	14
ARGENTINA	14	7#	7#	7	7	7	7#	14	21	21	21*	21*
AUSTRALIA	21	14	7#	7#	7#	7#	7#	7	14	14	21	21
CANAL ZONE	14	7	7	7	7	7	7	14	21	21*	21*	21
ENGLAND	7	7	7	3.5*	7	7	7#	7#	14	14	7#	7#
HAWAII	21*	14	7	7	7	7	7	7	14	21	21	21*
INDIA	7	14	7*	7#	7#	7#	7	7	7*	7	7#	7#
JAPAN	14*	14	7#	7#	7	7	7	7	7	7#	14	14*
MEXICO	14	7	7	7	7	7	7	14	14	14	21	14
PHILIPPINES	14*	14	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	7	14	21	21	21	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	21	21	14*
U. S. S. R.	7#	7	7	7	7	7	7	7*	7*	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	7	14	21	21	14

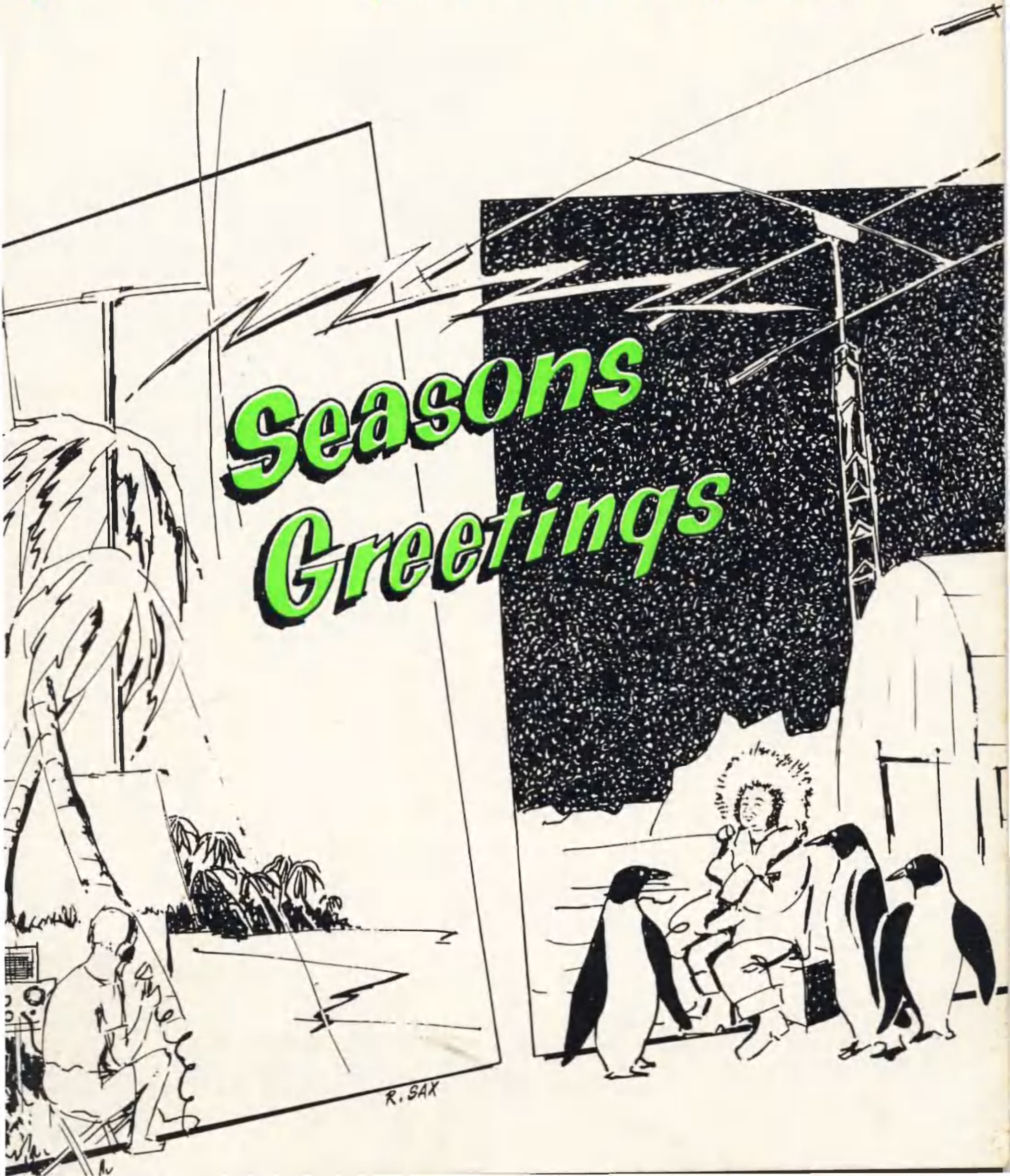
Very difficult circuit this hour.
* Next higher frequency may be useful this hour.

73

Amateur Radio

DECEMBER 1964

40c



73 Magazine

Wayne Green W2NSD/1
Editor & Publisher

Paul Franson WA4HWH/1
Assistant Editor

December, 1964

Vol. XXVI, No. 1

Cover:
Merry Christmas
WA2TKY

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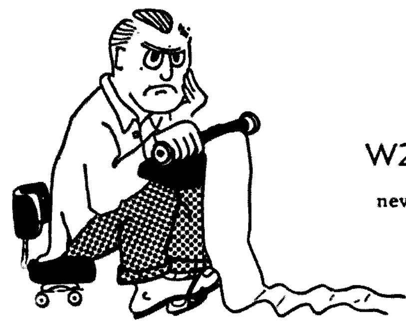


de
W2NSD/1

never say die

Christmas:

Remember, every dollar you spend on ham equipment will make for a merrier Christmas for your distributor and the manufacturer. Spread cheer. To help you in your selection I've inveigled an unusual number of advertisers into this issue. 73, along with the foliage, went red this fall . . . this burst of green was needed so don't grumble.

ARRL:

My November editorial still stands. Ham radio won't be able to hold up its head until the League top brass stops its petty politicking and dictatorial actions. It doesn't look as if the latest director elections are going to give us any hope for a replacement of the top officers with men who are more mature and stable.

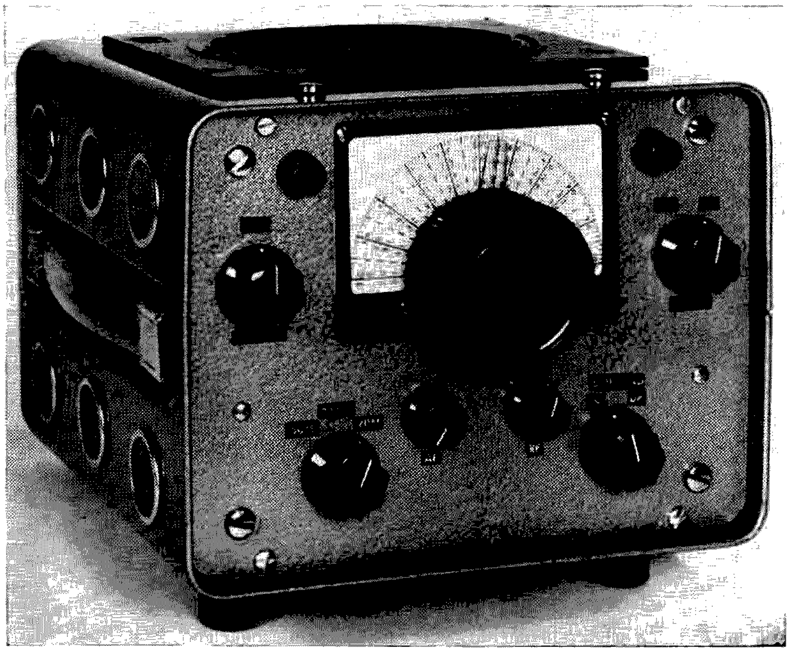
FCC:

Apparently the FCC intends to ram their docket to eliminate the Conditional Class license through. We'll watch this one carefully.

IoAR:

Look for some big news next month.

Cartoon by Wayne Pierce K3SUK



William H. Kennedy W3ZFJ
1520 James Street
Monroeville, Pa.

A 2 band mobile SSB Receiver with many unique features.

HO-2080SSBMR-1OT

This receiver was conceived, designed, and constructed with one aim in mind, mobile single sideband. It is now and has been operating in this manner for over one year with superb success. Sensitivity and selectivity are excellent. Dozens of comparitive tests have been made with other receivers and this receiver hears everything my 75A-4 hears or a KWM-2 hears. It's now being used with a companion 200 watt transmitter in the same size package which, incidentally, was an afterthought when the receiver was completed.

Since most constructing hams are familiar with basic operation of receivers, I will not go into a detailed explanation of each stage, but will hit only a few highlights and problems encountered.

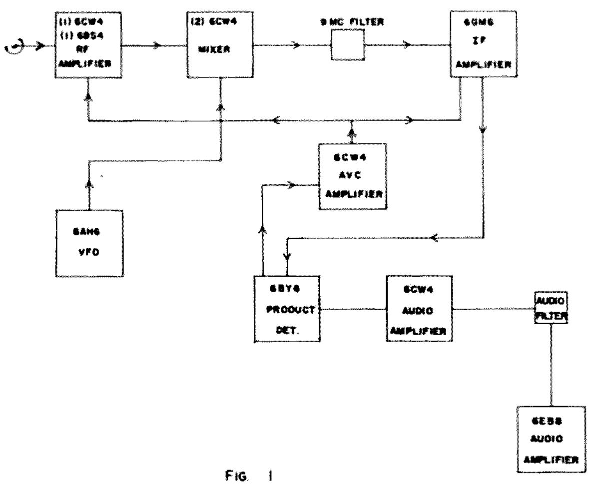
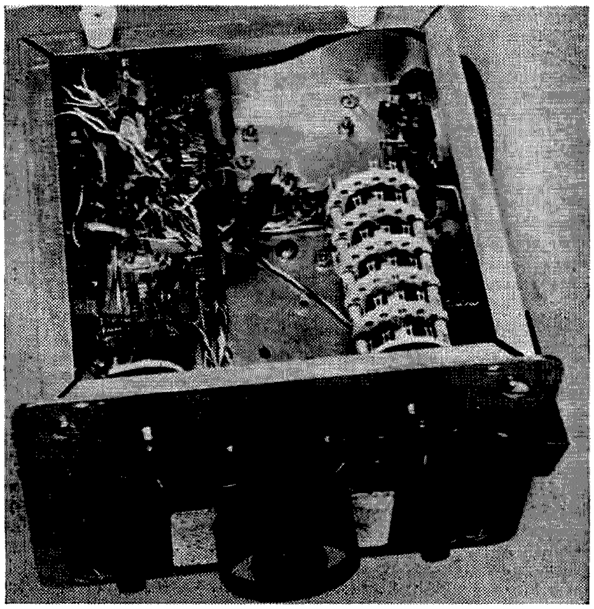


FIG. 1

Block diagram

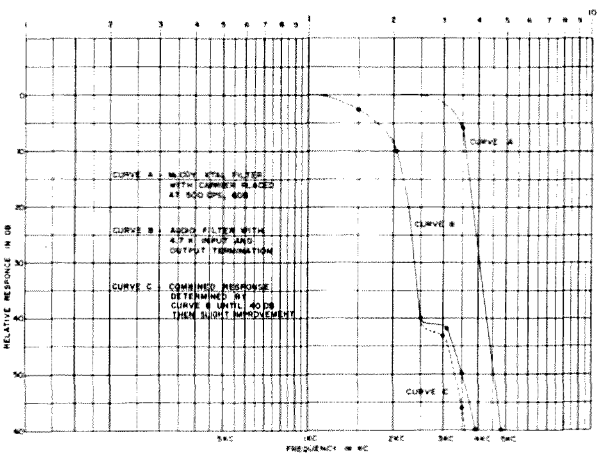


Bottom view of receiver

The block diagram (Fig. 1) shows only 8 stages, including the avc amplifier. Power requirements are necessarily slim for mobile service. Filament requires only 2.5 amps. at 12v and 200v at 70 ma.

The rf stage is a high gain cascode amplifier.

Already the communications engineers are screaming "cross modulation." Granted at full gain this receiver is no exception, however, when listening to a weak signal at full gain a strong local signal 20kc away is just barely detectable. Backing off on the rf gain just a little removes any trace of the strong signal. Measurements indicate that at this point the gain of the rf stage is approaching unity. You need only to use this receiver to fully appreciate the advantage of front end gain control. Most receivers control three or four stages and the front end is still operating at fairly high gain and therefore is susceptible to overload on strong signals. Of course in order to use this method the mixer must be of the low noise variety, as this one is, rather than a noisy 6BE6 or 6BA7. The bottom of the cascode stage is a remote cutoff 6DS4 nuvistor triode. This configuration will give you the characteristics of a remote cutoff pentode except without the noise of a pentode.

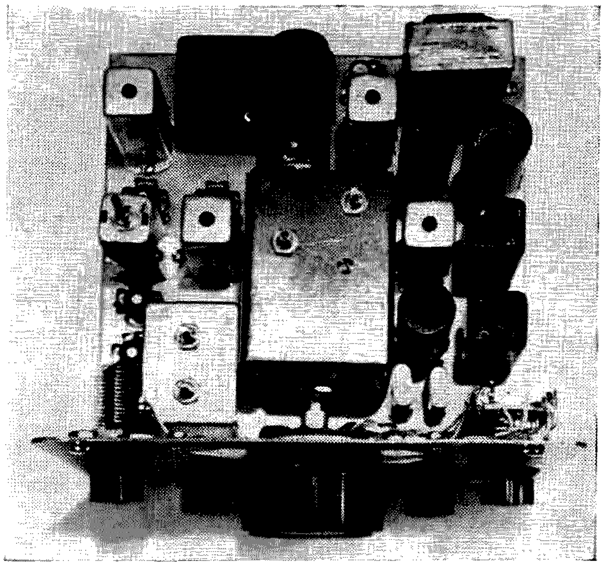


Selectivity

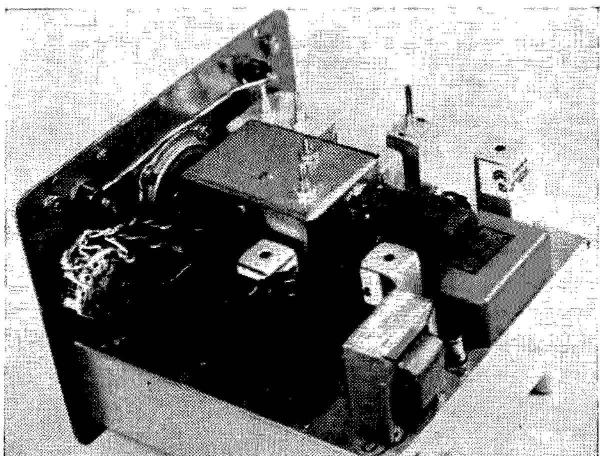
The mixer is the same high gain, low noise, and low cross modulation circuit described in the October 61 issue of 73. It works as well as the original 12AT7, but is scaled down in voltage for the nuvistors.

Please notice there are two filters in this receiver. The total bandwidth of both filters is 1400 cps at the 6db points. Actual audio response, however, at the 6db points is 500 cps to 1900 cps. Too narrow for phone operation? You should hear it. The xtal filter selects only one sideband and sets the lower audio limit to 500 cps. The audio filter alone sets the high end at 1900 cps.

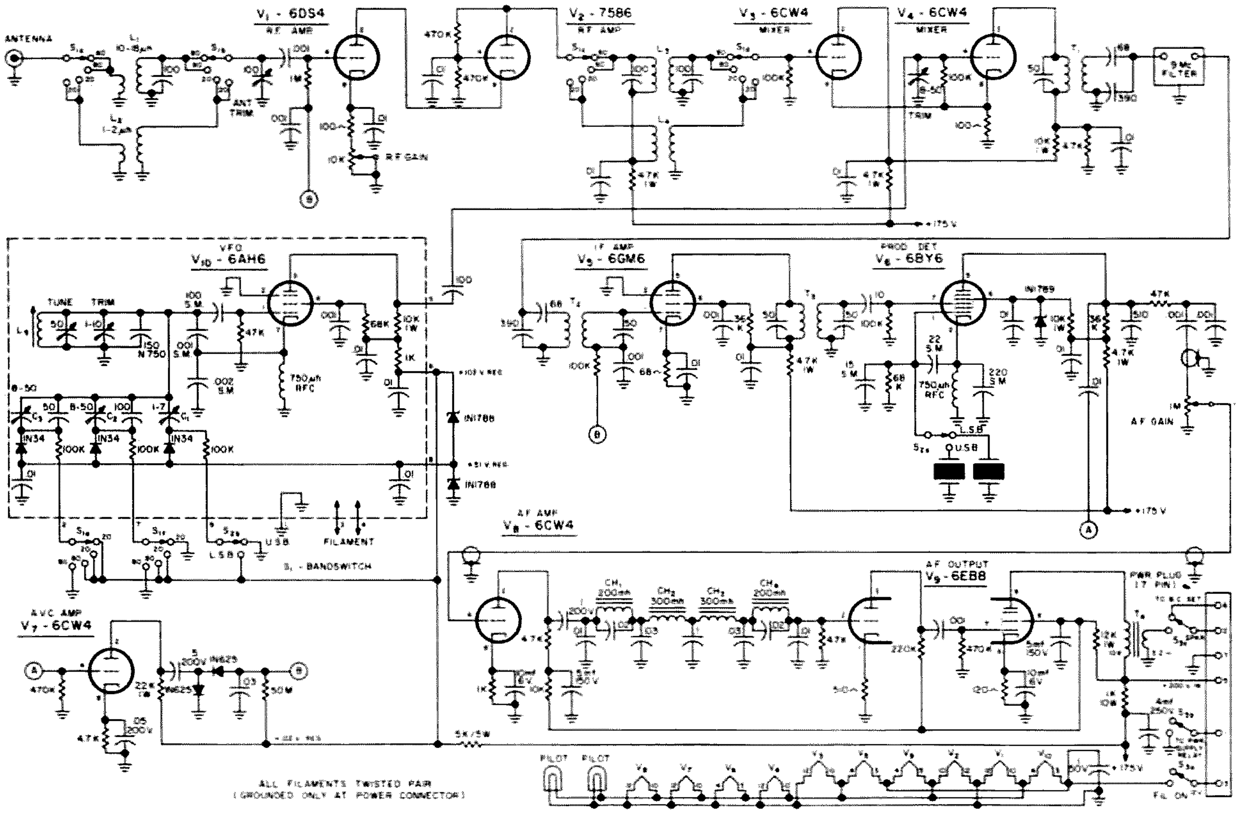
One must be careful when defining selectivity and bandwidth. You may have more bandwidth than you think. For example the Collins 75A4 normally has a 3.1 kc filter, but when you position your passband tuning properly the lower audio limit is about 400 cps. This places the upper limit at 3500 cps, almost


Top view of receiver

twice the bandwidth that is needed. Most of the new receivers and transceivers have 2.1 kc filters therefore the audio response is still up to 2500 cps. I maintain the top frequency should be no more than 2000 cps. This may sound like gilding the lily, but let's face it, the bands are crowded and when it comes to monkey chatter, "Every litter bit hurts." (ouch)


¾ view of receiver

The curve in Fig. 3 will show the combination of the filters. The bfo frequency was set at the 25 db point on the curve, setting the low frequency to 500 cps. Since the audio filter reaches its maximum depth before the xtal filter starts to roll off, the af filter is the high frequency defining aperture. Matching to the xtal filter is accomplished by modification of the standard Merit 10.7 mc *if* transformers as seen in the parts list. The audio chokes used in this audio filter were surplus units, obtainable from Olsen Radio Co., Penn Ave., Pgh., Pa. A



T1, T2 Merit 10.7 mc *if* transformers modified by removing the 33 mmfd and replacing one side with 50 mmfd and the other side with 68 uuf and 390 uuf ceramics.
T3 Merit 10.7 mc *if* transformer modified by adding 20 mmfd ceramic to existing 33 uuf.
T4 10 K to 4η output trans.
CH1, CH4 225 mh chokes.
CH2, CH3 300 mh chokes.
CH1-4 audio chokes are surplus Rola Co. GH-1226-2 available at Olsen Radio Co., Pgh., Pa. Substitutes are VIC-8 and VIC-9 UTC variable inductors.
Filter McCoy model 48B1 with matching bfo xtals.
Heat shield on 6AH6 vfo is model CFM7 by Cool-Fin Electronics, So. El. Monte, California.
L1 Miller 41A155CBI 10-18 μh with 10 turn link added.
L2 Miller 41A156CBI 1-2 μh with 5 turn link added.
L3 Miller 41A155CBI. Two coils one mounted on top of can, one mounted on bottom of can.
L4 Miller 41A156CBI. Two coils one mounted on top of can, one mounted on botton of can.
L5 10 turns #16 enamel wire wound and an XR-50 coil form.

good substitute would be the VIC-8 and VIC-9 UTC variable inductors.

The vfo is constructed in a heavy welded copper box. The mechanical and electrical stability is excellent. The drift in the first 30 minutes is 900 cps, after which it will sit on zero beat with the Collins for hours. This initial drift is very slow so you may use the receiver almost immediately after turning it on, a necessary requirement for most mobile work.

The dial calibration is not very well defined from the photos, but the dial is marked only with the 100 kc marks in each band. The vfo covers 14.25 to 14.35 and 14.00 to 14.10 on twenty and 3.90 to 4.00, 3.50 to 3.60 on 80 meters.

Band changing is done with diode switching and the four 100 kc segments are accomplished with only three changes in vfo freq. The dial shows 5 bands, but only four are used. A diode switch is used to shift the frequency 3 kc when changing sidebands so the input frequency remains unchanged. Voltage regulation is accomplished with Zener diodes as can be seen in the schematic.

The avc system employed works very well. It has none of the initial 'pop' common to a good many receivers. The attack time is approximately 300 μsec as measured on a Tektronic 585 ocilloscope. Release time is determined by the back resistance of the diodes and the 50 meg resistor. The 50 meg resistor is returned to B+ to provide a delay. An unexpected problem developed when the receiver was first tried mobile. Every time I would release the accelerator the B+ voltage would drop about 10v. This drop was seen as a large change on the plate of the avc amplifier and would cut the receiver off for about 5 seconds. This was corrected by returning the avc plate load to the regulated 102v on the vfo.

This receiver has given me a lot of enjoyment in the time I have used it. I have received a lot of compliments from friends and enemies alike, and I can say without reservation this receiver does not cause TVI.

. . . W3ZFJ

Clark Anderson W6NKZ

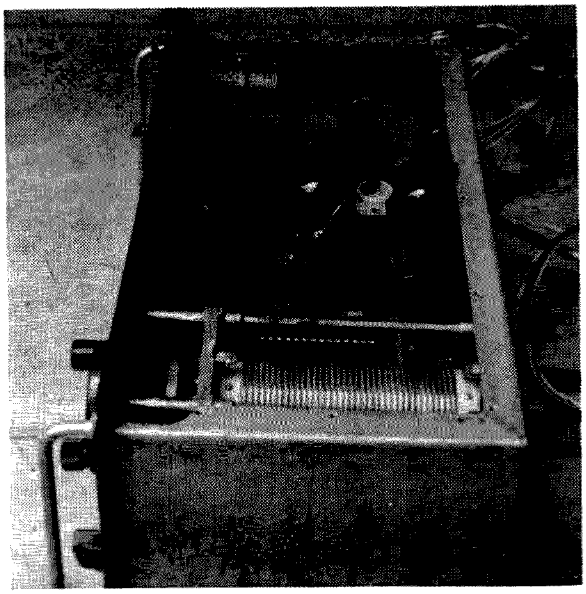
A Cheap Pair of Socks

The 6JB6 is a Novar tube with the suppressor grid brought out separately, not connected internally to the cathode (the common practice) and is supposed to have ratings similar to the 6DQ6. The recollection of the 6AG7 and the price invited the trial of the 6JB6's in a grounded grid linear.

Frankly, I was not too confident so a strictly junk box version was built. The results were very gratifying and should encourage others to give the tubes a try.

Four 6JB6's were paralleled and mounted in a BC191 tuning unit cabinet. The old holes were plugged with "Bondo", used for the new parts, or covered by the relocated tuning chart. The plate meter, roller coil and plate tuning condenser were all salvaged from the BC191. The loading condenser is a three gang TRF broadcast condenser and will probably require additional padding on 75 meters.

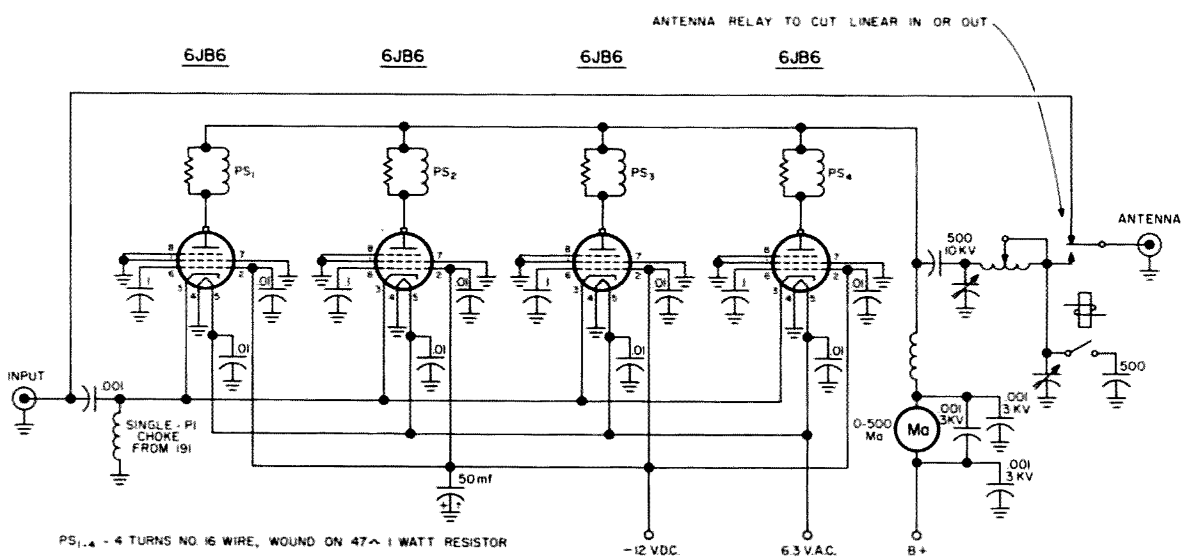
Construction was straight forward with no particular precautions except to place brass discs in the center of the novar sockets to provide better grounding and isolation; no trouble was encountered (which is unusual for W6NKZ, believe me). W6JPU gave encouragement to the project and the first trial at his QTH with a Variac showed that about 1200 volts was the limit without using bias. At this point the four tubes were dissipating 160 watts and beginning to blush. Forty watts apiece and one tube was beginning to get

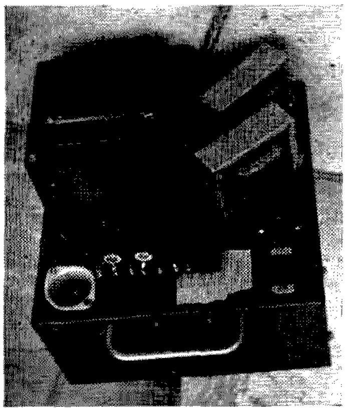


6JB6 Linear Amplifier

quite red, but would cool down with excitation. Tubes were interchanged with the same tube being the weak sister, which eliminated the possibility of a stray parasitic in one socket.

At this stage a power supply was built using a healthy TV transformer in a tripler circuit





Power Supply

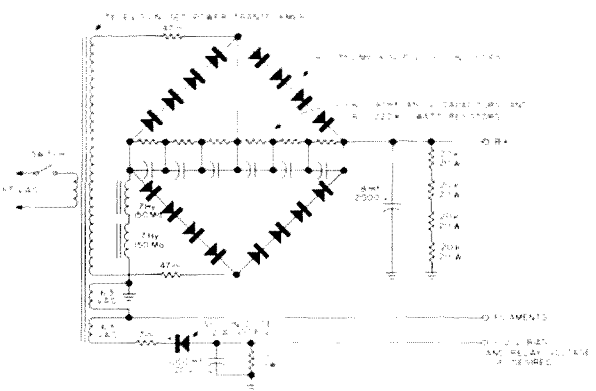
described in 73, June 1961.

Tripler is a slight misnomer; the switch was thrown and 1900 volts appeared to make the electrolytics sound like a rattlesnake. Two more condensers were hastily added and some voltage checks were made.

65 mils steady load—1900 volts
150 mils steady load—1620 volts
220 mils steady load—1600 volts

At this point resistors were smoking and I decided this was fair enough for the size and price.

With the power supply completed and 12 volts bias applied to the grids, the amplifier idled at about 40 mils—10 mils per tube. When properly loaded it would easily peak 400 mils and was very easy to drive with the untuned cathode circuit. On the air reports have been most complimentary and local checks have shown a very clean signal on the scope.



At a sustained 400 mils the tubes are just beginning to show color, which would indicate 1600 volts to be about the limit for the "conservative amateur" or a confirmed whistler.

This article was written with the hope of encouraging a little experimentation and not with the idea of this being the last word.

. . . W6NKZ

Photo by E. C. Current

L. F. Kiner K6VNT
1213 Pacific St.
Santa Monica, Cal.

Build a
28 Volt Power Supply

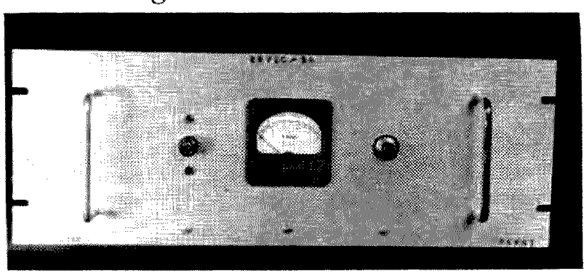
There is really no need for you to be passing up those surplus 24-28 volt dc transmitters, receivers, relays, switches, coaxial relays, lights, etc!

For less than $20.00 you can build a power supply that will provide 24-28 vdc at 10 amperes.

The circuit is a straight forward dc power supply circuit employing four silicon rectifiers in a bridge circuit and suitable high-capacitance-low-voltage capacitor for filtering.

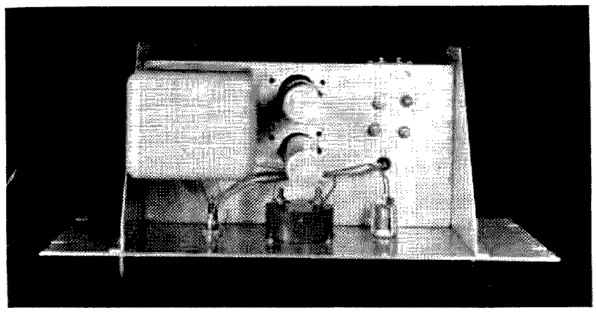
The power supply can be built on any practical size chassis that will accommodate the components to be used. Construction is noncritical as to parts placement. I used a 7 × 9 × 2 aluminum chassis and mounted this to a standard rack panel by means of support brackets. Rack panel mounting is of course optional.

When wiring the unit it is suggested that the builder use No. 12 or No. 14 solid wire. This is the same type of wire as generally used in your house wiring. About a three to four foot length should be sufficient.



Most of the surplus stores can supply a power transformer that will do the job very nicely. Price? The range is from $5.00 to $10.00 each depending on condition and current carrying capacity. One that will do the job is available from Hiway Company (1147 Venice Blvd., Los Angeles 15, California) for $7.25 prepaid. This particular transformer will deliver 24 vac and 10 amperes from 115 vac 60 cps source.

Of course you can also obtain your 24 vac by wiring the secondaries of two 12 vac filament transformers in series (or the secondaries of four 6.3 vac filament transformers). The primary windings would be paralleled and a check with an ac voltmeter will tell you whether you have the secondaries connected properly. Be sure to check the secondaries with an ac voltmeter to insure that your connections are series aiding (adding) and not cancelling.



The rectifiers (diodes) used in the original unit were purchased from TAB (111-54 Liberty Street, New York 6, N.Y.) for $1.15 each. The units selected are the 12 ampere, 70 vrms (100 piv) silicon power diode studs. Be sure to use mica (or equivalent) insulating washers when mounting the diodes to the chassis.

Metering of the current drain and output voltage is optional. I had a dc ammeter that wasn't in use and installed it on the rack panel. Since a dc voltmeter of suitable range was not available, pin jacks were provided to check the voltage whenever desired.

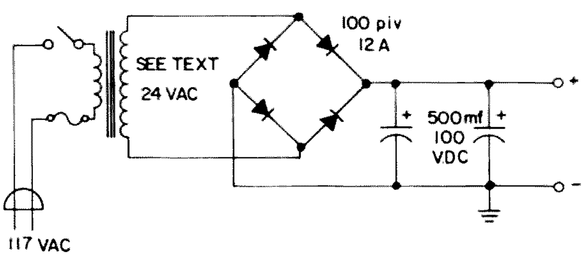


FIG. 1

A heavy duty 24 vdc power supply such as this will most likely be more than ample to fulfill any needs of the average experimenter or amateur radio operator.

I use all 24/28 vdc switching, coaxial relays and pilot lamps. These are readily available at nominal cost in surplus stores.

Don't pass up those 24-28 vdc bargains anymore; the relays alone are worth investing in a power supply.

. . . K6VNT

Jim Kyle K5JKX
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Weather Detector

Here in the tornado-prone Southwest, one of the most spectacular feats of public service performed by hams has been the group of "Weather Nets" which aid the weather bureau and news services in keeping track of severe weather. A number of lives have been saved by the action of such nets.

But while this aspect of severe weather, public service, and ham radio, appears to have been confined principally to the tornado and hurricane belts of our country, the potential of mixing the three ingredients is available almost anywhere.

One of the more interesting recent examples is suggested by an article appearing in the May, 1963, issue of *Scientific American* magazine, in the publication's department devoted to "The Amateur Scientist."

Described is a complex-appearing (but actually far simpler than a SSB exciter) device which when completed tells you the direction and intensity of thunderstorms. Its range is some 600 miles; its azimuthal accuracy is limited only by the care in construction. It's no weather radar—but it does much the same job.

And at the conclusion of the article, almost as an afterthought apparently, the author comments that two or three such azimuth stations, separated by 100 miles or so, could obtain accurate fixes on thunderstorms "if the problem of establishing communications between stations can be solved. Perhaps the solution can be found in amateur radio."

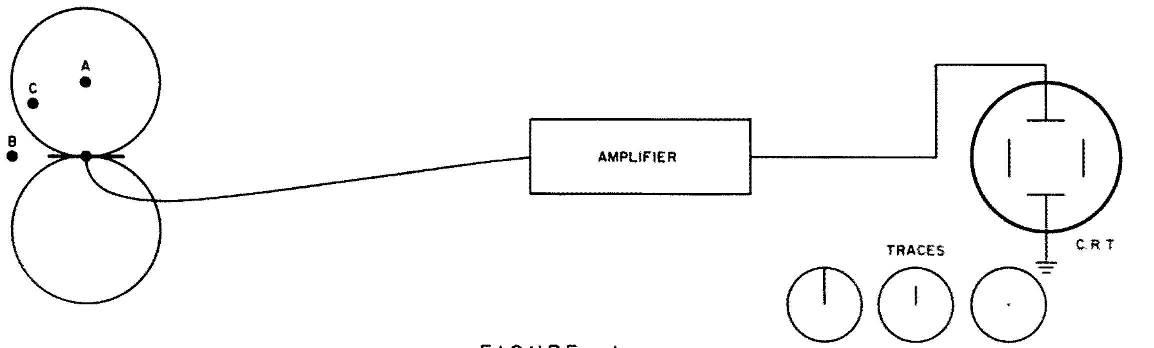


FIGURE 1

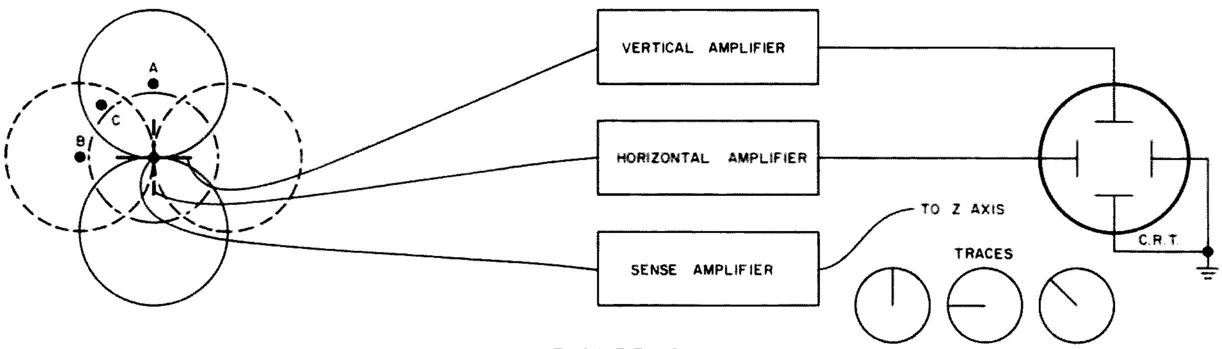


FIGURE 2

So if you're looking for something new, different, and a little bit out of the way to spend your construction talents on for a spell, you might consider the weather detector. If you and just one buddy 100 miles away from you each build one, you'll have the virtual equivalent of a weather radar station so far as locating thunderstorms is concerned. And there's a chance that your observations might uncover some of the unknown details about thunderstorms which the professionals haven't discovered yet!

Actually, the weather detector as developed by Mr. Thomas P. Leary, an Omaha, Neb., at-

torney, consists of a radio-compass with oscilloscope readout. Complete constructional details appear in the *Scientific American* article mentioned previously, but most hams will be able to build a working model from the block-diagram description which follows:

Input to the weather detector comes from three antennas. Two of these antennas are shielded loops, identical to those used for transmitter hunts (Leary used 50 turns of No. 20 Formvar covered wire on a 3-foot form, shielded with a wrapping of aluminum foil). The third antenna is a vertical "sense" antenna to remove ambiguity.

The loops are positioned at right angles to each other, and feed identical amplifiers. The amplifiers have frequency range from 100 cps to 12 kc; any hi-fi or phono amplifier should work but high gain is essential. Leary used a 12AU7 feeding a 6AU6 to achieve sufficient gain.

The "sense" antenna feeds a similar amplifier; all three amplifiers are provided with gain controls to allow balancing, and a special "stereo-matched" twin gain control for the loop amplifiers might not be out of place to avoid rebalancing.

Outputs of the two loop amplifiers go to the horizontal and vertical plates of the scope tube, respectively, while the output from the sense amplifier goes to the grid or the "Z" input of the scope.

Operation of the system can best be understood with reference first to the single-channel block diagram, Fig. 1, and then to the complete diagram, Fig. 2.

Fig. 1 shows only the vertical-deflection channel loop, amplifier, and scope circuit. A thunderstorm producing QRN at point A will be picked up strongly by the antenna; the QRN will be amplified and applied to the deflection plates, and the result will be a vertical line whose height is proportional to the strength of the QRN.

However, an identical thunderstorm at point B will lie in the null of the antenna and will not be picked up, while a third similar storm at point C will be received but with only about half the strength of the one at point A.

Now turn to Fig. 2 to see how addition of the horizontal channel changes things. Now the storm at point A is in the horizontal null and the vertical peak, so it still produces a vertical line on the scope face. But the storm at B is in a vertical null and horizontal peak, so it produces a horizontal line. And the storm at C produces signals in both channels; the strength in each channel is proportional to the angle of the radial line to the storm, and this effect results in a diagonal line pointing directly toward the original storm.

The Sense antenna's output, fed to the grid of the CRT, blacks out the "tail" half of the trace produced by each storm, so that the appearance on the screen is simply a line from the center of the tube (observer's position) indicating azimuth to the storm.

Most lightning discharges are vertically polarized, and the weather detector produces the line on the screen when receiving vertical-polarized energy. However, some cloud-to-cloud strokes are horizontally polarized, and some distant strokes received by sky-wave will be simultaneously vertical and horizontal. The horizontal component produces a sort of spade-shaped trace, with the tip at the rip of the screen, while the combination of both vertical and horizontal results in an oval with a straight line down the middle.

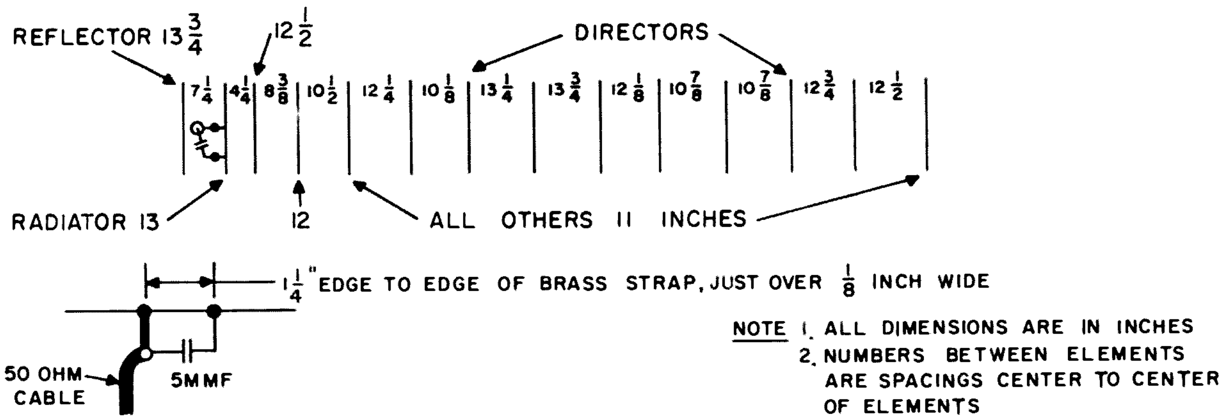
Only a few precautions are necessary when constructing a weather detector. One of the most important is to make all antenna feed cables the same length to preserve exact phase relationships. The Sense antenna should be connected to a "lightning arrestor" since the equipment will be operating during thunderstorm conditions. The loops should be oriented on N-S and E-W lines although this refinement is not necessary if they are at accurate right angles to each other; however they should be at least 20 feet above ground.

This weather detector can also be used to spot probable tornadoes, since the twisters are invariably accompanied by strong thunderstorm activity and turbulence. To quote Mr. Leary: "My station has produced an elliptical display with rapidly recurring sferic pips on the azimuth of a small tornado 24 miles away." He adds that any storm producing repeated pips on the identical azimuth is suspect.

. . . K5JKX

14 Elements on 432

K1CLL



RADIATOR DETAIL

Just to jog your memory, remember that as you go up in frequency the absolute necessity for an antenna designed for the band grows by leaps and bounds. This was already evident in the good old 5 meter days, 30 years ago. On ten meters, you could use a "long wire antenna," (generally the 160 meter "flat-top L") some 270 feet long and as high as you could get it. If it was pointed towards Europe, it also pointed West. But not on 5! You had to do something then.

Now that we're on ¾ of a meter take my word for it: Build at least one good multi-element Yagi to start off with. I built two, because from past experience it was nice to have two complete stations. You could loan one of them to a friend and thus be sure of at least some QSO's.

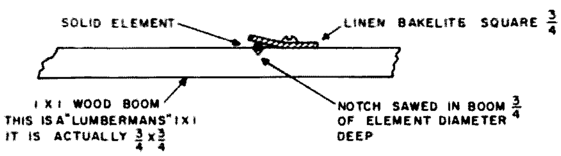


FIG. 2

So just make up one for now. Unless you want to live it up with a 14 over 14! It uses 1" by 1" red cedar or redwood, small squares of bakelite to hold the elements on, wood-screws, and aluminum clothesline for elements. It has 14 of these wide spaced for maximum gain, a fixed capacitor Gamma match, nearly 20 db gain, and it works!

This beam is not a copy of any other. I tuned this one up myself over weeks and weeks on the antenna range here. With some 23 years experience in back of that. Some handbooks claim that all the directors after the first few can be equally spaced. You can. But if you want to be sure of the gain of this one, make it up precisely as indicated. Note

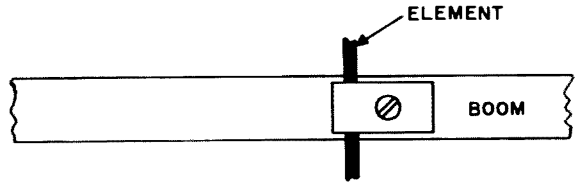


FIG. 3

that they came out pretty near equal but not quite.

Figs. 2 and 3 show element mounting detail. Fig. 4 shows material details. One nice feature about the thin solid aluminum elements. They *bend*! Several times if need be. You can use this beam as a "standard" also for your own antenna range, etc., as you go to more elements later. The construction is light but with a little varnish sprayed on, it will do for a while. You'll probably want to put up two or four a little later, anyway.

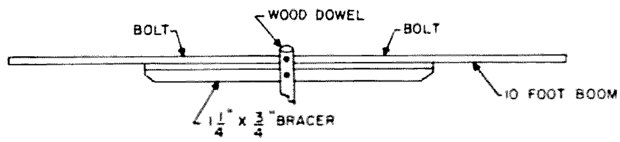


FIG. 4
SIDE VIEW, BOOM AND BRACER

I used a one inch dowel for the first part of the mast, (that is, the part attached to the boom) plus a length of black plastic ABS (acrylic butadiene styrene) pipe over it. This just happens to be a good fit into the ends of the very useful 5 and 10 foot sections of aluminum Tee Vee masts—that are sold in every "radio store."

Seems like that's enough detail. See you *soon* on 432. There's quite a few on the band already, I find.

. . .K1CLL

The Miniature Multiband Tuner

Joe Williams W6SFM
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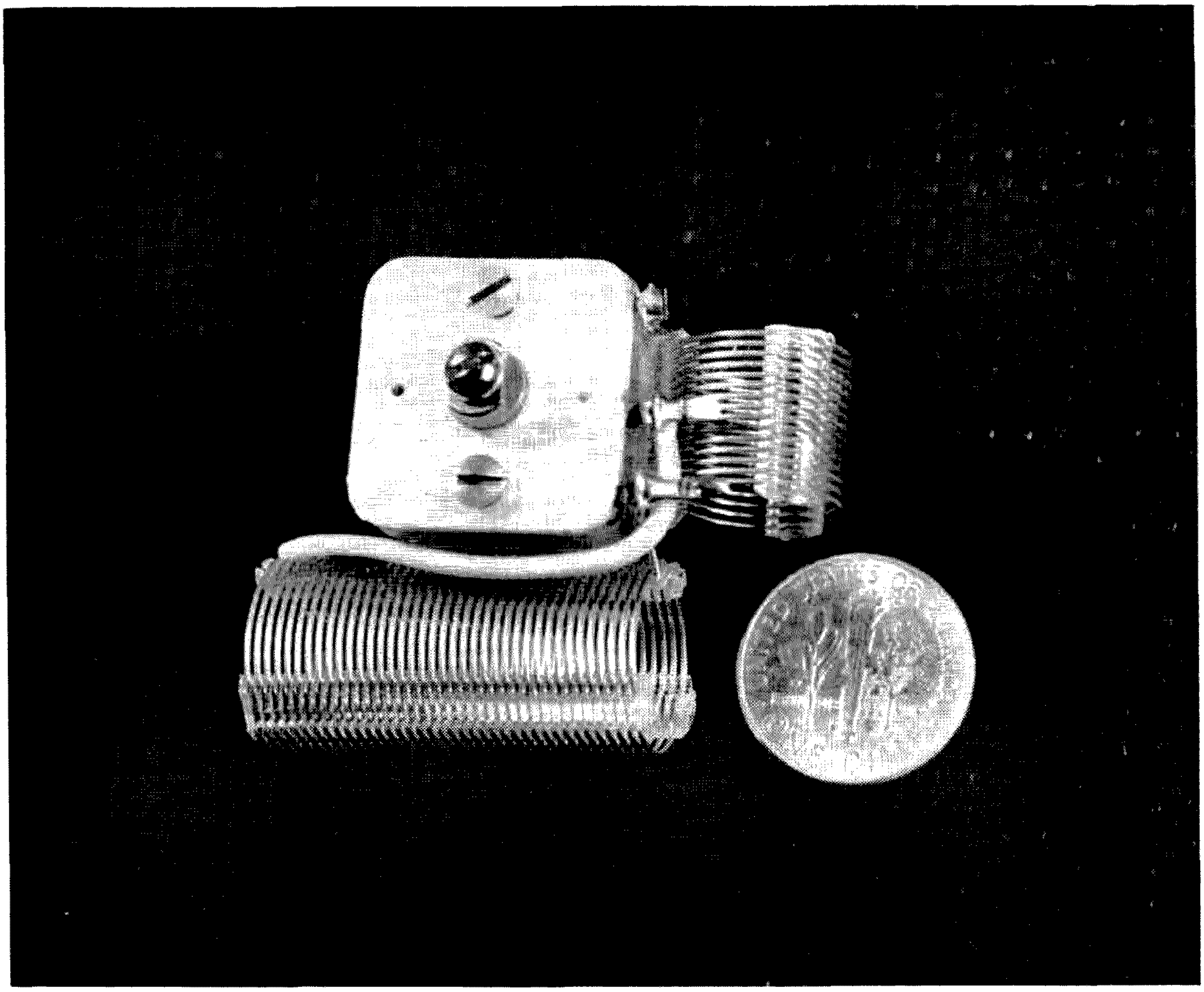
North Hollywood, Calif.



Multiband tuner construction data has been yellowing in the pages of amateur literature for a long time and hasn't really received the attention that it deserves. There was a time when the typical hamshack needed a shoe box full of plug-in coils to keep it going and some of them were of the type that were wound on a tube base and doped with a bit of fingernail polish. That was back when the Zepp antenna was the end-all and a store bought rf inductance was a glossy showpiece. Since then, the ARRL handbooks have described some interesting and functional all-band rigs using multiband tuner circuitry. A typical handbook version of the single ended MBT employs a dual 140 mmfd variable capacitor and inductances of 1.5 and 8.9 microhenries. In the commercial field, the National Company markets the MB40 and the MB150 multiband tuners which are popularly accepted home brew ingredients.

In essence, the multiband tuner works like this: two right angle mounted inductances are tuned with one split stator condenser. (Fig. 1). The hook up is such that the smaller

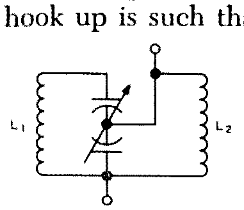


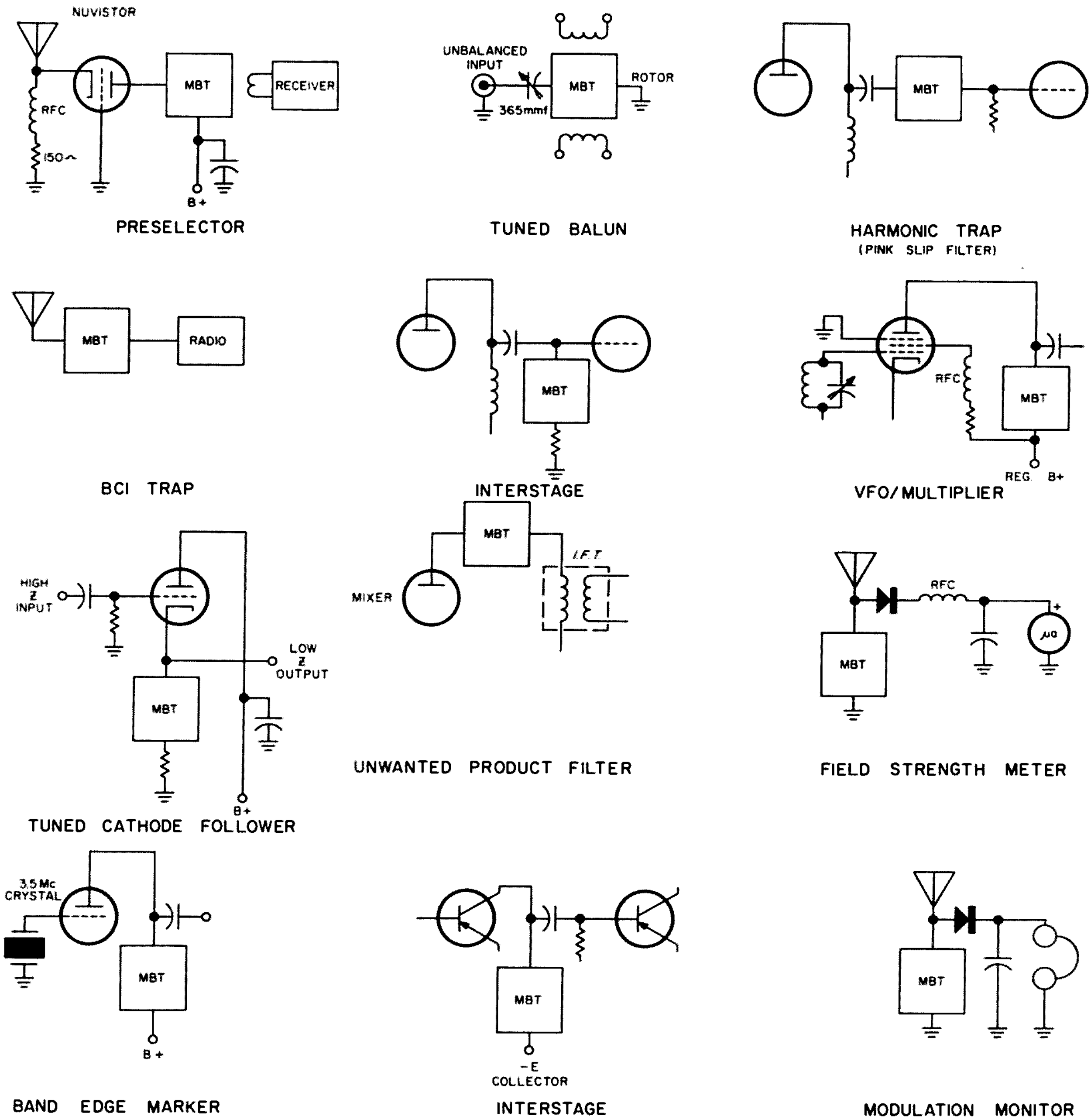
FIGURE 1

coil, L 1, is tuned by connection to the variable low value series capacity existing between the stators. The large coil, L 2, which is connected from the rotor to one stator, is of such size as to be seen by the small coil as an rf choke and therefore nonexistent. To the

larger inductance, the small coil appears as a short circuit between the stators and the two sections of the capacitor are thus shunted. This combination of effects enables the tuner to provide a parallel-resonant, high impedance, tuned circuit for each of the five popular ham bands from 80 through 10 meters.

The miniature tuner shown in the photograph was assembled for use in some Nuvistor projects and is infinitely useful where the power involved is 5 watts or less. The tuning condenser, which measures $\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$ inch, is a CalRad model CR 201 and is of the type used in the smaller transistor radios. The antenna section is 11 mmfd to 235 mmfd and the oscillator section covers 11 mmfd to 111 mmfd. The inductances, L 1 and L 2, were made from one stick of Air Dux 432 T. (The Barker & Williamson equivalent is #3004). This coil stock has an outside diameter of $\frac{1}{2}$ inch, runs 32 turns per inch and has molded plastic bindings. L 1 is 16 turns and L 2 is 40 turns. First, L 1 was solder tacked to the stators and pruned to tune 10, 15 and 20 meters. After L 2 was cut to include 40 and 80, each coil was cemented to a rear edge of the dust cover of the condenser. In this case, Testor's Polystyrene Cement seemed a good chemical match for the dust cover and the coil plastic. When the cement had set, the coils were properly soldered to their respective connections. The CR 201 has small trimming pads on the back and these were used to make sure that the tuner didn't 'hit' two bands at the same dial setting. The plastic frame and the mounting screw arrangement on the front of the condenser permit the tuner to be chassis, bracket or thin panel mounted. When an MBT is used in a plate circuit, or other scheme involving above chassis voltages, the rotor shaft should be insulated. The builder can fabricate shaft extensions of plastic or other material and will find that Epoxy cement is handy for attaching them solidly once the mechanical details of the application have been worked out. A vernier dial makes it easier to re-set the MBT and as the capacitor is meshed, the bands should resonate in this sequence: 10, 40, 15, 20, and 80.

Where link coupling is desired for the midget tuner, the link coils can be made up of 2 to 5 turns of small gauge insulated wire. These may be wound so that they will fit inside L 1 and L 2. Normally, a link is required for each coil and the links are switched when going from one range to the other. Sometimes, however, it is possible to get good results by linking to L 1 only. The presence of a link coil in L 1, or in L 2, will lower the res-



onant frequencies somewhat and calibrations should be made with that fact in mind.

A Chinese copy of this tuner can be made in your shack for a few bucks; but you can easily fake an MBT with on-hand components from the junk box. A Grid Dip Oscillator is convenient for measuring the frequencies as construction proceeds but is not a necessity. A multibander can also be checked by inserting it between an antenna and the station receiver. When the tuner coincides with the receiver frequency, it will knock a hole in the incoming signals or noise. This way, one's calibration goofs can be blamed on the receiver manufacturer. It will be found that the lower frequency coil can not be calibrated until the smaller coil is installed, so L 1 should be checked out first. Another bear trap that can bring out the builder's best dial cord repair language is the temptation to tune an MBT by shorting coil turns with solder. This short cut *will* raise the frequency—but it will also strangle the "Q" and will steal a lot of signal energy. If a multiband tuner is to be enclosed in a metal box or mounted on a panel, final calibration should be made with the tuner in its working position.

Fig. 2 shows some MBT circuit application prototypes; these diagrams are not designs and have been made sketchy on purpose. Doubtless, other uses for the multibander will suggest themselves to the builder.

. . . W6SFM

Photo credit: Robert Jensen

Jim Young W6WAW
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The Bamboo Birdcage

The G4ZU Birdcage is a distant relative to the familiar Cubical Quad. One of the original design approaches of the Birdcage was to use tubular elements, thus not requiring the use of bamboo arms. However, this results in an array that requires considerable mechanical rigidity if it is to survive a good wind, in turn adding to the weight. The can become a detrimental factor in erecting a 14 mc antenna

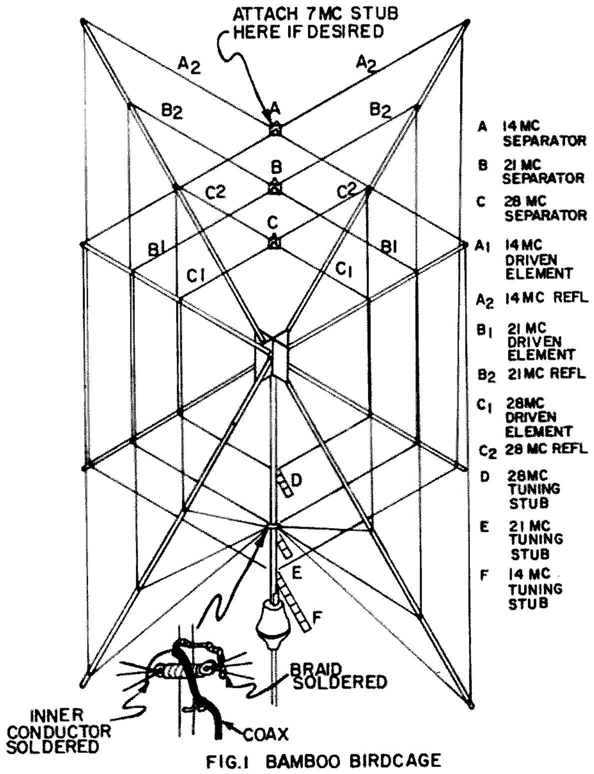

FIG. 1 BAMBOO BIRDCAGE

atop a mast of reasonable height. The Quad on the other hand is of sufficiently light weight so that under most conditions a 14 mc model can easily be erected by two persons. However, the basic Quad design suffers from a lack of rigidity unless an exceptionally strong boom is used. The boom length in turn makes the array somewhat hard to handle.

The use of a "Boomless Quad" has therefore become quite popular, with the added advantage of providing proper spacing between elements on dual and tri-band versions to permit a good match to be obtained to a single coaxial line. This configuration, however, requires longer bamboo arms than the basic Quad, and a rather complex "spider" at the center.

By combining the electrical design of the "Birdcage", with the mechanical design of the "Boomless Quad", we can obtain an antenna which contains the best features of both configurations, as shown in Fig. 1.

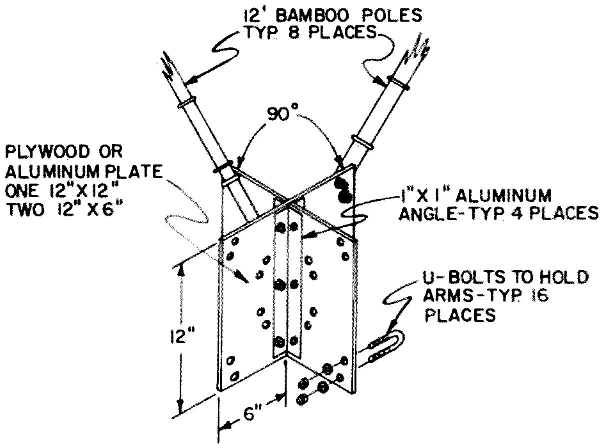

FIG. 2 SPIDER CONSTRUCTION DETAIL

The basic "spider" is detailed in Fig. 2. This may be constructed from either sheet aluminum or plywood, depending upon which is more readily available. The eight arms are then mounted at a 45° angle from the horizontal and the "spider" mounted to a ten foot length of 1¼ inch TV mast by means of "U-bolts". A separator plate, as shown in Fig. 3, should then be made up for each band. This can be cut from Micarta, Lucite, or even wood if it is well varnished.

BAND MC.	ELEMENT LENGTH	TWISTED LOOP	TUNING STUB LENGTH*
14	36'	9'	48"
21	23'	6'	36"
28	18'	4' 6"	24"

* Two #14 wires spaced 3 inches apart. (not shorted)

The elements are cut from #14 wire, to the lengths given in Table 1. Cut four elements for each band (two for the driven element and two for the reflector) and solder a lug to both ends of each element. Twist a single loop about ¼ inch in diameter and solder well, at the distance given in Table 1 from each end of the elements. Also make up two jumpers and a reflector tuning stub for each band. The jumpers are used as shown in Fig. 3, while the tuning stubs are attached as shown in Fig. 1.

Connect the element ends for each band to the separator plates and install the jumpers.

Using two of the 28 mc elements, center the separator plate over the top of the mast section, so that the twisted loops are the same distance from the ends of the bamboo arms. Using several turns of #14 wire, secure the loops to the bamboo arm and solder well. Now secure the other two elements the same way.

Attach the 21 and 14 mc elements in the same manner, making sure that the jumpers for all three bands are in the same plane. If 7 mc operation is also desired, do not use a jumper on the 14 mc driven element. Instead, connect a 28′ length of 300 ohm twin lead between the driven elements at the separator plate. Short the other end of the stub and tape for insulation.

Connect the ends of the drive elements to a length of 50 ohm coaxial line as shown in Fig. 1, and attach the tuning stubs to their respective reflector elements. The antenna is now ready to be mounted on the rotator and tuned.

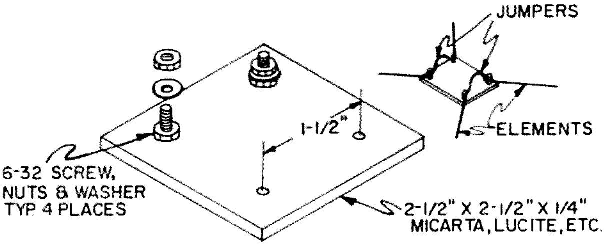

FIG.3 SEPARATOR PLATE DETAIL

Tuning can be accomplished using a station a mile or so away as the signal source, and adjusting the shorting jumpers on the stubs until best foreward gain is obtained on each band. Then rotate the antenna 180° and repeat the process to obtain the best front-to-back ratio. Usually these two adjustments will coincide; however, the forward gain is fairly broad, while the front-to-back adjustment is somewhat more critical.

The coaxial line can be passed thru an eye-bolt to bring the center of the elements in at the mast, while the tuning stubs can be folded back up the mast if desired. The 7 mc stub can be dropped inside the mast, or taped to the outside, whichever is more convenient.

The completed antenna should provide about 7 db of forward gain, which is approximately 2 db better than the average two element Quad, while the front-to-back ratio should be at least 25 db. The turning radius for the "Bamboo Birdcage" is also slightly less than the Quad, while the whole assembly weighs less than 20 pounds.

. . . W6WAW

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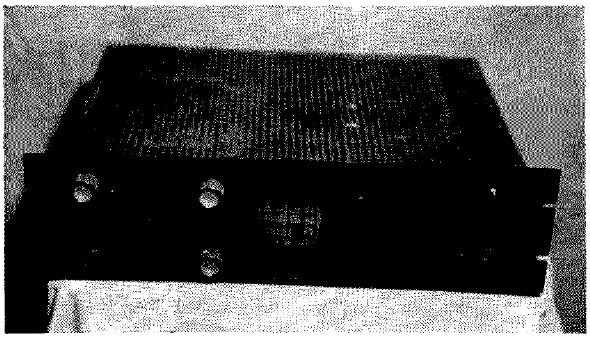
Going RITTY—Part Two

Now that we have convinced you that RTTY is not expensive, that no special technical knowledge is required and you have acquired a machine, it is assumed that you want to get to printing.

Your question now is . . . what do you need?

If you will refer to the block diagram that appeared in the article "Going RTTY" in the January 1964 issue of 73, you will see that you need a converter to complete your receiving setup.



RTTY Convertor.

Let's look at the converter situation and see just what is required. There are two types of converters and in both types their main function in the overall circuit is to change incoming signals into dc pulses that operate the selector magnets on the machine.

Since our purpose here is to get you copying RTTY signals, we will not deal with the technical aspects of converters. You can find a wealth of material on this subject in the HAM-RTTY handbook.

So let's get right on with a simple converter that does an excellent job. The circuit in Fig. 1 uses only the necessary parts to do the job and all frills omitted.

You will note from the photos that I have employed a "progressive" type of construction. That is, the converter is wired in one complete section. The monitor scope, which can be added at any time, is built as another section. The power supply also is constructed as another unit and all three are removable from the overall chassis for servicing or adding additional circuits as required.

For those interested in the construction details, a 4″ × 13″ × 17″ aluminum chassis was used. Cut out the top leaving a lip all around of ½ inch. The section cut out is then cut to make two sub-chassis; one for the converter and the other for the power supply. A strip of light aluminum will be required to make the third sub-chassis for the monitor scope.

Each of these sub-chassis is cut to allow a ½ inch bend at each end and still fit against the front and rear wall of the overall chassis. They are held in place with small aluminum self tapping screws.

The whole assembly is mounted on a 5¼ inch by 19 inch standard relay rack panel, while the top and bottom are covered with perforated aluminum which is attached to the edge all around with aluminum self tapping screws.

As to the converter itself, there is nothing new about it. It has been used by RTTY'ers for some years in this or some modified form, and was selected because it is easy to as-

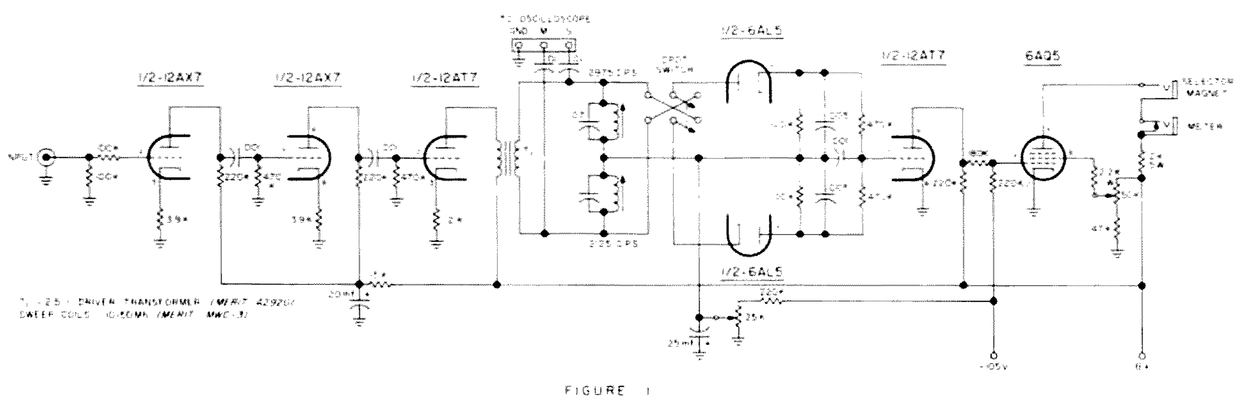
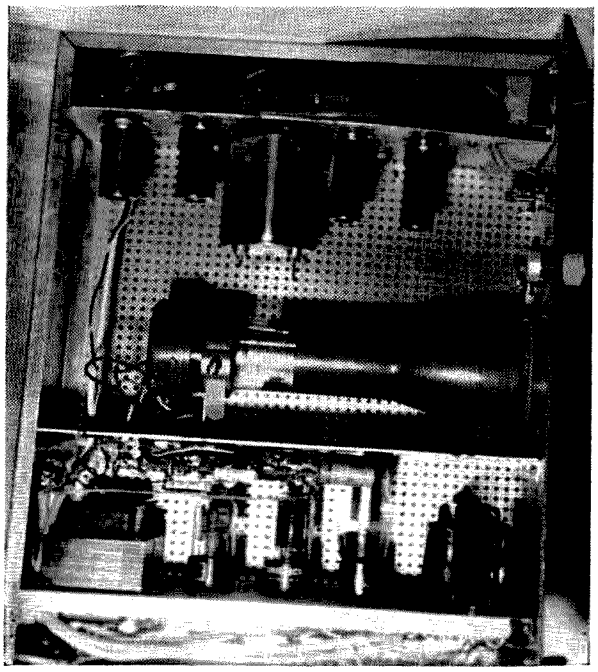


FIGURE 1

The 1 mfd capacitor in the 2125 cps circuit should be .1 mfd.

semble and uses parts that are on hand in most junk boxes or can be picked up from local surplus houses. As can be seen from the schematic, the wiring is easy and since there is nothing critical about it, it should work the first time it is hooked up. Just a few simple instructions are offered:



Top view.

Be certain that the meter jack is of the closed circuit type. The output jack is open when the plug is removed. Both of these jacks are insulated from the chassis since there are about 200 volts present in the circuit at this point.

A 100 milliampere meter should be inserted in the meter jack for making adjustments. It may be left in the circuit after adjustments are made or may be removed, since the closed circuit jack will close and current will pass.

In the final adjustment of the converter turn the control bias down to zero and the current adjust down to minimum screen voltage. With your machine connected at the output terminals of the converter, apply line voltage and turn on the power.

After warmup, without any audio input being applied to the converter, there will be no output current indicated. At this point feed a 2975 cps audio signal to the input and adjust the coil with the .07 mfd condenser across it for maximum indication on the scope, which of course is connected to the scope terminals on the converter.

Reset your signal generator to 2125 and adjust the other coil slug for maximum scope presentation. This presentation will be at right angles to the first.

Now with no audio input, start your machine and adjust the bias control until the loop current reaches a steady value. It should read about 18 or 20 mills with the current adjust pot set to minimum.

Now you can adjust the current control for the printer current desired. You may find that you will need to back off on your bias control slightly and reset it until the magnets pull in.

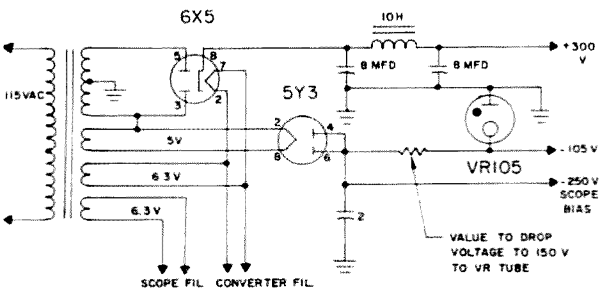
The meter should read about 30 mills at this point. When a signal is fed to the input of the converter, the meter current will show a sharp swing up to about 50 mills, and will continue this swing as the signal is received.

A few tries will give you the proper adjustent know-how and you will soon find the machine rattling away with perfect copy being received.

Details of the monitor scope will be the subject of another article, so leave room to build the scope as part of the overall assembly.

Credit is given to W4TJU for the basic converter circuit which is used here.

The power supply shown in Fig. 2 was designed to provide power for both the converter and the monitor scope, and voltages in-



T-1 ANY 600 VOLT CENTER T
80 M
FILTER CONDENSERS 8 MFD 450 V

FIG. 2

Power supply.

dicated should be closely followed since if they are much different than those indicated, the dc amplifier in the converter will not operate correctly and as a result the converter will not function properly.

. . . W4RWM

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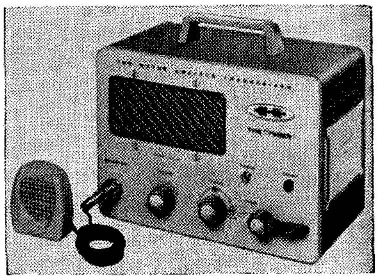
SIXER to the Nth



The Heathkit Sixers and Twoers are well known as fine and flexible pieces of gear. With a few additions and modifications, however, a good deal more operating ease and efficiency can be obtained from these rigs.

Power Supply

Going first to the power supply, I found that the trouble-free operation enjoyed at the home QTH had a habit of literally going up in smoke in the mobile. The problem is quickly and permanently solved by replacing the diodes with International Rectifier type SD-92.

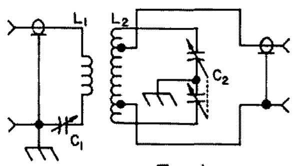


Fig. 1

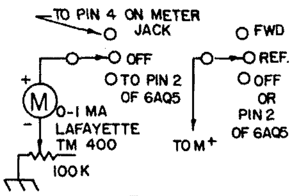


Fig. 2

Fig. 1. Coupler diagram.
Fig. 2. Two of the possible switch combinations, using three position rotary. If spdt toggle switch is used instead, an off position is recommended.
C1-100 mmfd variable for 50 mc, 50 mmfd for 144 mc (Hammarlund MC100, MC50)
C2-35 mmfd per-section split stator variable, .07" spacing (MCD-35SX). Reduce to 4 stator and 4 rotor plates per section in 144 mc coupler for easier tuning.
L1-50 mc: 4 turns, #18 tinned, 1" diameter, 1/8" spacing. (Air-Dux #808T)
144 mc: 2 turns #14 enam., 1" dia., 1/8" spacing. Slip over L2 before mounting.
L2-50 mc: 7 turns #14 tinned, 1 1/2" diameter, 1/4" spacing (Air-Dux #1204). Tap 1 1/2 turns from each end.
144 mc: 5 turns #12 tinned, 1/2" diameter, 7/8" long. Tap 1 1/2 turns from each end.

Receiver

The Sixer receiver, as known to anyone who has ever used a super-regen, is not the epitome in receiving excellence. More than one normally timid soul has been moved to acts of violence during a band opening thanks to its lack of selectivity. Efforts to relieve this situation electrically did not bear enough fruit to merit mention. Mechanically, however, I have found that a 2" vernier dial (Lafayette F-347) (99c) is of considerable help to the poor OM with coffee nerves who can't tune the ungeared dial onto the best side of the squealing signal. Two months of tinkering convinced me that the tuning condenser should not be pushed back into the rig. Success was finally achieved by cutting the condenser shaft, leaving only about 1/8" protruding from the panel surface, and cutting the vernier dial shaft through the set-screw hole. Mount the dial without the top mounting screw or set screw and you're set. The pressure of the dial on the condenser has held everything in place perfectly for me, but if any slipping is experienced, a drop of glue (or chewing gum maybe?) will hold it tight. Due to different design, this mounting system is not applicable to the Twoer.

The only other addition to the receiver was a closed-circuit phone jack mounted in the upper left-hand corner of the panel and wired in series with the hot lead to the speaker.

Transmitter

The transmitter was attacked next, and, if you'll pardon my Caesar, *utrimque acriter pugnatum est.*[1] Having become fed up with futile attempts to tune the tank without removing the rig from the case, I first devised an external tuning method. Start by soldering the threaded sleeve from an H. H. Smith type 105 phone tip to the screw head on the ceramic trimmer. Next scrounge for a screw (approximately 3/4" in length) that will fit the sleeve and replace

[1] Translation: "It was fought fiercely on both sides."

its head with a small knob. Finally, mount a rubber grommet in one of the air holes opposite the trimmer. Simply push the "screw-knob" through the grommet, and screw it into the sleeve. All this nonsense will give continuous clockwise and limited counterclockwise rotation of the condenser.

Undoubtedly the smartest thing I did all week was to add an antenna coupler to the Sixer. For the benefit of anyone too cheap to own a *Handbook*, the schematic, adapted for coaxial output, is reproduced here. This innocent looking gadget, built into a 3″x4″x5″ grey hammertone box, will load into practically anything; in fact K2LLC used it to load his Poly-Comm 62B into a window screen with a 1:1 swr. You should find it particularly useful in the mobile, where standing waves often run amuck. If used in conjunction with a low pass filter, it should be mounted on the left side of the rig with the filter screwed onto the case at one end and onto the coupler (with a spacer) at the other.

Naturally, some method was needed for adjusting the coupler. No problem. Mount a 0-1 ma meter, a 100,000 ohm pot, and a spdt toggle or three position rotary switch as shown in the photo. The popular little "Monimatch" swr bridge should fit nicely inside the coupler box, with phone tips coming from the switch, through the air holes near the coupler, and into jacks on the box. Or, if you're as lazy as I am, you can do what I did: monitor the so-called "power output" device in the Sixer or Twoer (tuning CI on the coupler for maximum and C2 for minimum), and use the other switch position to monitor the "kick" in your modulation. Or you can monitor the filament current and pilot-lamp voltage and say the heck with the coupler.

Operating convenience was jacked up one last notch with the addition of a crystal socket on the front panel (see photo). Simply run shielded leads from the panel socket and plug them into the chassis socket.

When the smoke cleared, I decided to rewire the transmitter section with shielded grid wire. The apparent increases in harmonic suppression and circuit efficiency were more than worth the effort (the neighbors got off my back and the dummy load burned out).

Finally, I replaced the Sixer's 6CL6 final with a 5763, which squeezed another watt or two of rf out of my Benton Harbor Kilowatt. Don't forget to rewire the tube socket.

That about sums it up. By now, your Sixer or Twoer should be operating more efficiently than ever. . . . K1GHO

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Two'er Talk

During the past 4 years, I have had occasion to chat on 144 mc with several stations using Heath TWOers. Some of these useful little transceivers deliver excellent results for their owners. There are, however, a number of these TWOers which are suffering from transmitter instability, TVI, bassy audio, abnormally low output and audio distortion. A few of these ills are caused by poor workmanship when the kit was assembled. The bulk of the ailments mentioned result from engineering problems which can quite readily be corrected.

Numerous articles have been written and dedicated to circuit modification of these handy little portable packages. Little has been said about the more predominant problems which exist in them. Some of these articles described the addition of push-to-talk relays, panel meters, squelch circuits, etc. The basic ailments which relate to efficient operation have not been presented. While sitting back on the sidelines, watching many of the fellows struggle with these common problems, I decided to acquire a TWOer of my own and attempt to resolve these more troublesome circuit bugs. After studying the circuit diagram, applying standard procedures and sweating over a moderately hot soldering iron for a short period of time, I ended up with a TWOER which possessed all of the attributes common to a well engineered VHF transmitter.

Analysis

The final tank circuit could be modified to provide much greater efficiency and reduced TVI.

The P.A. stage would no doubt benefit from neutralization inasmuch as both the driver and P.A. are in a common envelope, operating on the same frequency.

Capacitor values in the speech amplifier and modulator stages could be changed to reduce bass response and give the signal greater "punch."

High level-negative peak clipping could easily be added, to further increase audio punch and aid in the elimination of possible "overmodulation."

Conventional coax fittings could be added to the rear apron of the TWOer, to facilitate use with other station equipment and antenna feedlines.

Removal of the diode metering circuit could prevent bleeding of rf power from the transmitter output and reduce TVI caused by the harmonic action typical with diodes.

With great enthusiasm, the above changes were made. The results were well worth the small amount of effort.

The Modifications

P. A. Tank—Replace the final amplifier tank coil with 4 turns of #12 wire, ½" in diameter × 1" long. (Silver plate if possible.)

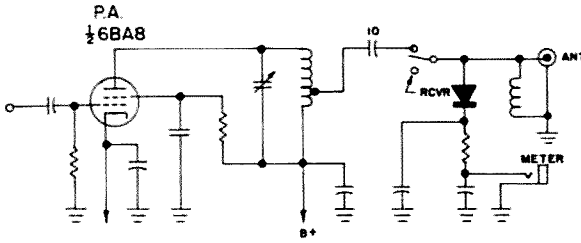

FIG. 1-A

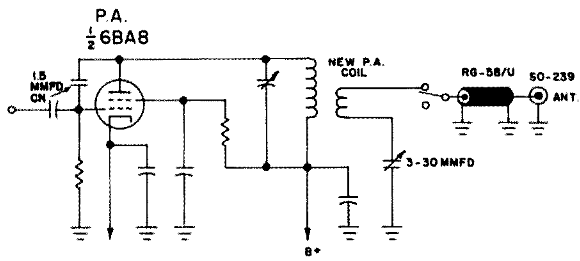

FIG. 1-B

Remove the 10 mmfd output coupling capacitor from the P.A. Tank coil. (This will reduce TVI and permit a better match to the feedline.) Replace the capacitive output circuit with a 2 turn link of #20 formvar or nyclad wire, inserted in the B+ end of the new tank coil. (Make certain the link is wound in the same direction as the tank coil.) Return this new link to ground through a 3-30 mmfd mica trimmer. This will be used to effect a proper match to the feedline and reduce reactance.

Replace the bus wire connecting the antenna fitting to the TRANSMIT-RECEIVE switch with a short length of RG-58/U coaxial cable. Be sure to ground the shield at both ends of the new cable. (See Fig. 1-B.) This further improves feedline matching and circuit isolation.

Neutralization of the P.A. Stage—Due to the self neutralization frequency of the 6BA8

P.A. tube, it became necessary to employ POSITIVE neutralization. This is actually less complicated than the conventional methods of neutralization. Add a 1.5 mmfd ceramic capacitor from pin 7 to pin 9 at the tube socket, keeping the pigtails as short as possible.

This modification eliminated all signs of instability, cleared up all signs of FM, downward modulation and audio distortion and roughness. TBI was further reduced until it could no longer wipe out channel 7. Faint cross hatch remained. (See Fig. 1-B.)

Replace the .01 mfd coupling capacitor between the 12AX7 plate pin and the 6AQ5 control grid, with a .005 mfd disc ceramic. Replace the 25 mfd cathode by-pass electrolytic on the 12AX7 stage, with a 10 mfd 25 volt unit. Replace the .01 mfd 3 KV by-pass condenser connected from the modulation transformer tap to ground, with a .005 mfd 3 KV ceramic unit. These changes resulted in better high frequency characteristics in the audio system. Readability under weak signal conditions was improved. (See Fig. 2-B.)

Clipping—There is no audio gain control for the modulator. This means that it is necessary to remain a proper distance away from the microphone to prevent "overmodulation." This can be a source of annoyance when operating mobile. This extra audio which is available, can be put to use in the form of "clipped modulation" which will increase the weak signal readability of the transmitted signal. To add this High Level Negative Peak Clipping, simply add a 500 ma top hat type silicon diode to the modulator output circuit, as shown in Fig. 2-B. You can now "move in" on the mike without fear of distortion, etc.

Antenna Fittings—Replacement of the present antenna connector with a standard SO-239 chassis type receptacle, will permit use with standard cables and other station accessories. This is easily done by enlarging the existing mounting hole with a ⅝" chassis punch.

Metering Circuit—In some TWOers I have tested I discovered that the metering diode and allied circuitry bled a portion of the rf output energy away from the feedline. Removal of the entire network increased the transmitter output considerably. In addition, the metering diode encouraged harmonic output, which in turn contributed to TVI. Once this circuitry was removed, the remaining TVI disappeared. Without this metering provision, it becomes necessary to tune up by a different means. In my case, I tune for maximum forward power as noted on my SWR bridge. This should be no handicap, inasmuch as most well equipped VHF stations have an SWR bridge as standard bill of fare.

Conclusion

Before modification of the circuitry, as noted above, the measured output of the TWOer was .78 watts. Similar readings were taken with other TWOers. Following modification, the output increased to 2.4 watts into the same dummy load. No trace of TVI could be found. Prior to modification, channel 7 was wiped out. Reports of excellent audio quality and quantity were received following the circuit changes.

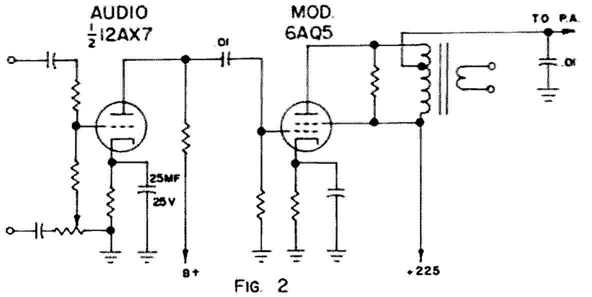

FIG. 2

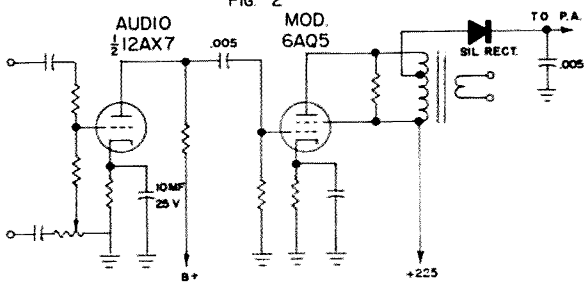

FIG. 2B

Regardless of the manner in which the multiplier stages and the P.A. are tuned, no instability would occur. Audio distortion and downward modulation completely disappeared.

Other refinements could have been made to the TWOer, but the ones mentioned in this article were of greater importance.

No changes were necessary in the receiver portion of the transceiver. Having built several regen type 2 meter receivers, I must say that the one contained in the Heath TWOer is the best I have seen in such simple circuitry. It is stable, sensitive and exhibits no "dead spots" in the tuning range.

With my modified TWOer, I have been able to work considerable distances over the rough terrain common to Northwestern Lower Michigan. I am using stacked A-62 Finco antennas on a 75 foot tower and feeding them with low loss balanced feedline and a VHF type Matchbox. I have been able to hold regular Q-5 schedules with WA9DOT in Grafton, Wisconsin. The distance is 165 miles, airline. Other similar contacts have been made without the aid of band openings.

Good luck on your TWOer changes!

. . . W8HHS

An Idea Article

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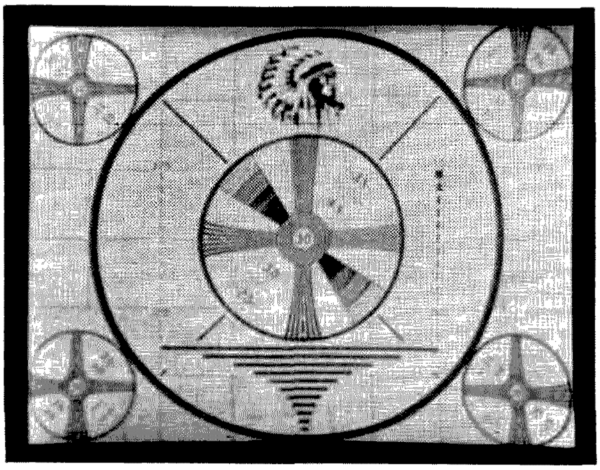
High Level Modulation for Ham T-V

Several interesting articles concerning ham TV have appeared over the last couple of years. If this writer had the time and the where-with-all to finance the camera and synch generator end of the system, he would certainly be drawn to this facet of amateur radio. Since time and material do not permit the construction and operation of such a system, this article will take the form of a suggestion for someone already engrossed in ham TV to experiment with.



Types of video modulation commonly used: All of the articles investigated, and in fact, all commercial TV transmitters in this country, use some form of low level modulation. RCA has built some transmitters that actually modulate the last stage, but even so, it is still grid modulation. Technically this is low level modulation. (Fortunately, in TV the amplitude modulation is mostly negative which does permit higher efficiency in the modulated stage than under normal AM as used for sound.) Why hasn't high level plate modulation been used? The answer is quite simple. Most people think of plate modulation as being transformer coupled between the modulator and the modulated stage. So far nobody has come up with a modulation transformer that will pass frequencies on the order of 10 cycles to 4 megacycles.

A possible solution: The series modulator will be found in the literature as far back as 1918 when an original patent was held by Heising. However, the series modulator has been a subject of academic interest only, because it has been regarded as a very inefficient method of modulation and one calling for too much power supply. This writer has been told that there are certain European TV transmitters that have used the system quite successfully.

Referring to Fig. 1, let us see what the series modulator actually does. The series modulator tube is nothing more than a variable resistor which varies at the modulation frequency. It makes no difference to the plate modulated stage whether the series modulator is on the plate or cathode side of the tube. But since the previous video stages refer to ground it is most convenient to place it on the cathode side. In standard plate modulation, for sound, it is necessary that the series modulator have more plate voltage than the plate voltage of the modulated stage. This is necessary so that on the positive half of the audio cycle the modulated stage will have twice the unmodulated value of plate voltage, to get 100% positive peak modulation. Thus the supply for a modulated stage requiring 1000 volts would have to be something in excess of 2000 volts when the series modulator is added.* Furthermore, the modulator tube itself would have to be quite large.

As indicated above, a series modulator seems rather impractical from the standpoint of regular AM. But how about TV? In TV the AM is very non sinusoidal; in fact,

* For example: An unmodulated stage requires 1000 volts at .1 amp. At 100% positive peak modulation the same stage requires 2000 volts at .2 amp. Since the series modulator does not have an internal resistance of zero at this point there will be from 300 to 500 volts still across it.

standard commercial TV uses a positive modulation of no more than 15% and the negative peaks are on the order of 85%. This puts the use of a series modulator in quite a different light. We no longer have the problem of very high voltage supply. For the forementioned amplifier requiring 1000 volts, the total voltage could be less than 1500 volts: 300 to 500 volts for the series modulator, and 1000 for the modulated stage. Negative peaks are no problem since as the voltage goes up across the modulator tube the current goes down. So a tube with relatively small plate dissipation could be used.

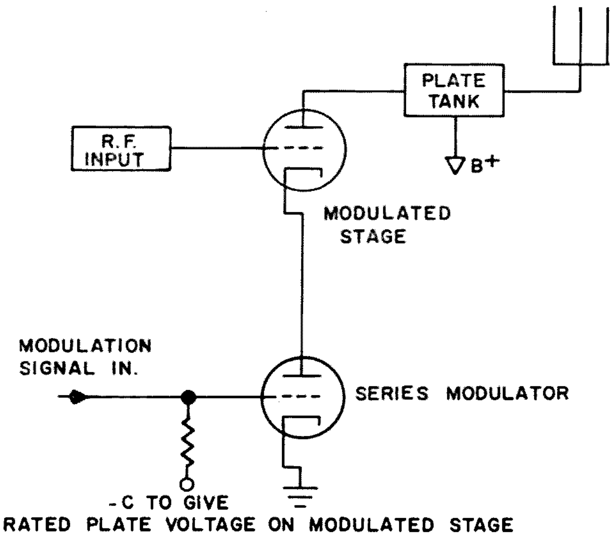


FIG. 1

Suggestions for trial: It is thought that satisfactory results will be afforded for ham purposes if a triode series modulator tube is used. If the very high video freuqencies are attenuated, some form of inverse feed back or high frequency peaking may be necessary. If loss of highs due to the Miller effect is too great, a screen grid type series modulator might be used.

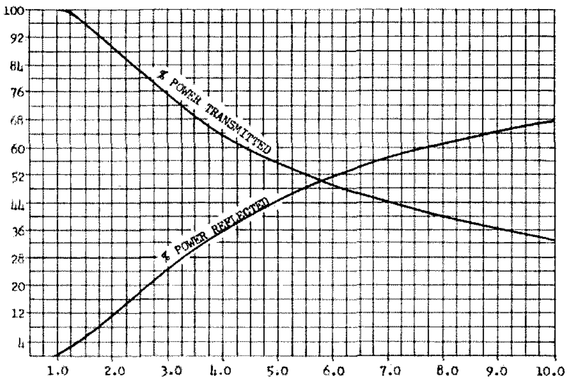
Actual case: As was stated at the begnning of this article no equipment has been constructed, so test results are not available. However, sometime back for entirely different reasons the author had occasion to build a very small transistorized TV transmitter. For commercial reasons the circuit is not included here but series modulation of one transistor by another transistor was used. One photograph of a test pattern transmitted by this milliwatt sized rig is shown. If it can be done at the milliwatt level with transistors, surely it is within the realm of possibility that it can be done at the kilowatt level with tubes.

. . . W7CSD

J. R. Fisk WA6BSO

That Elusive SWR

Although the virtues of operating transmission lines with low standing wave ratios (SWR) have been discussed many times in the past, evidently the economics of maintaining low SWR's are not readily apparent, particularly if the frequency of operation is low and the transmission line short. This has been reflected in various pseudo-technical QSO's where many have been led to the utter disregard for standing wave ratios. Most members of the amateur fraternity exist on limited budgets at best and when a significant portion of that precious transmitted power is eaten up by transmission line losses and misinterpreted standing wave ratios for naught, something should be done.



SWR vs % Power Transmitted and Power Reflected

Figure 1

A look at the graph in Fig. 1 will show you the percentage of power reflected for various standing wave ratios. For instance, if you are presently tolerating an SWR of about 5.8:1 (not uncommon in many ham shacks), 50% of the power which reaches the antenna is actually reflected back down the transmission line, heating up the final tank and causing TVI. Nor is only the transmitted signal effected, a high SWR will similarly degrade the received signal. This is particularly important in the reception of the extremely low level signals often encountered in DX and VHF operating. Stereophonic buffs should take heed too. A recent report by the IEEE (Institute of Electronic and Electrical Engineers) Professional Group on Broadcasting noted that a high SWR on receiver antenna inputs causes a reduction of stereo quality.

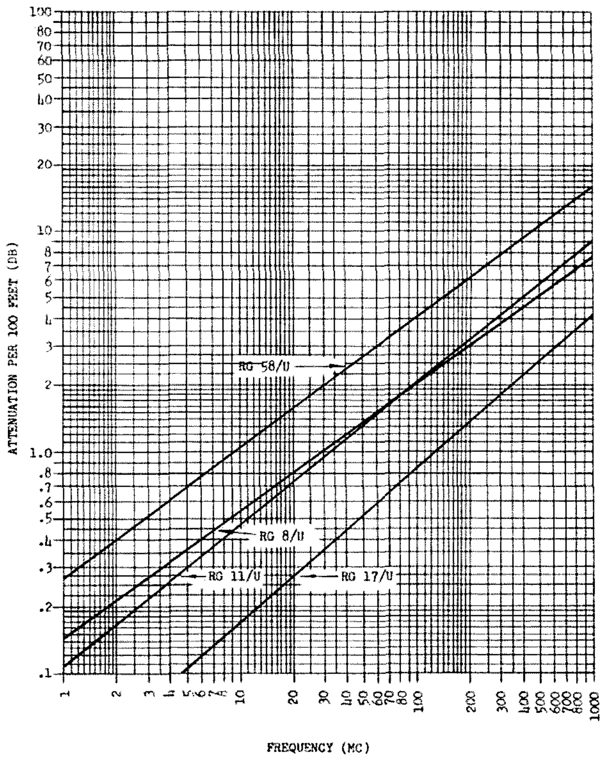


Figure 2

Attenuation vs frequency.

Many of the amateur stations on the air today make use of RG8A/U coaxial cable. Its excellence is proven out by its extensive use by the military, but a look at the loss graph (Fig. 2) for this cable indicates that it is not completely lossless! Even at 4 mc it has approximately 0.3 db loss per 100 feet, and on six meters there is a loss of 1.4 db for the same length. A look at Fig. 3 indicates that on 75 meters only 94% of the transmitted power is delivered to the antenna if 100 feet of RG8A/U is in use. At 50 mc the loss has sky rocketed to 26% for the same length of line. However, there is one big hooker for

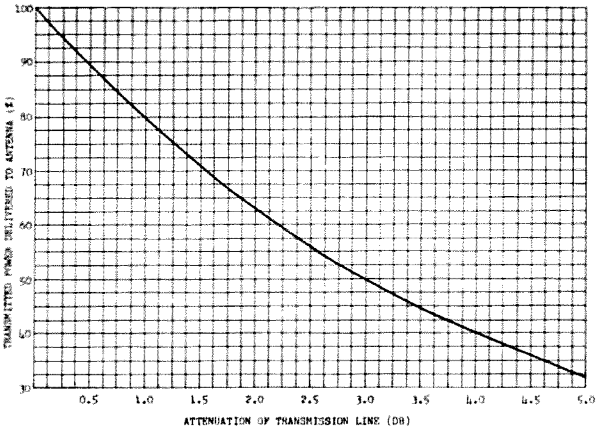


Figure 3

Attenuation vs Power transmitted.

these conditions to exist: the SWR must be 1:1. For any other value of SWR there will be further line losses as shown in Fig. 4 because standing waves have the property of multiplying attenuation. This graph indicates that if a transmission line is operating at an SWR of 3.7:1, the line loss will be multiplied by a factor of two. For the previously mentioned situation on 50 mc, an additional 24% loss could be expected with an RG8A/U line operating at an SWR of 3.7:1.

It should be obvious by now that the use of an SWR bridge in the line at all times is very advantageous in the maintenance of a low SWR at the operating frequency. However, contrary to popular belief, the SWR bridge does not tell all. Since there is loss or attenuation in any length of transmission

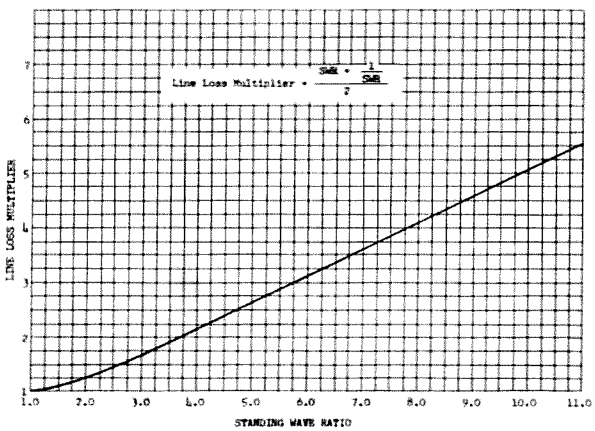


Figure 4

Line loss multiplier vs SWR.

line, the reflected wave will be attenuated in the same matter as the transmitted or incident signal. Because the standing wave ratio is the ratio of the incident wave to the reflected wave, attenuation of the reflected wave will give erroneous SWR measurements when the SWR bridge is conveniently located at the transmitter. In this location the bridge will see the full power of the transmitter, but only a portion of the reflected signal. In some cases where the length of the transmission line is excessively long, the reflected wave will be attenuated to such a degree that the SWR will appear to be very close to 1:1, while in reality it will be a good deal higher. This fact is graphically represented in Fig. 5.

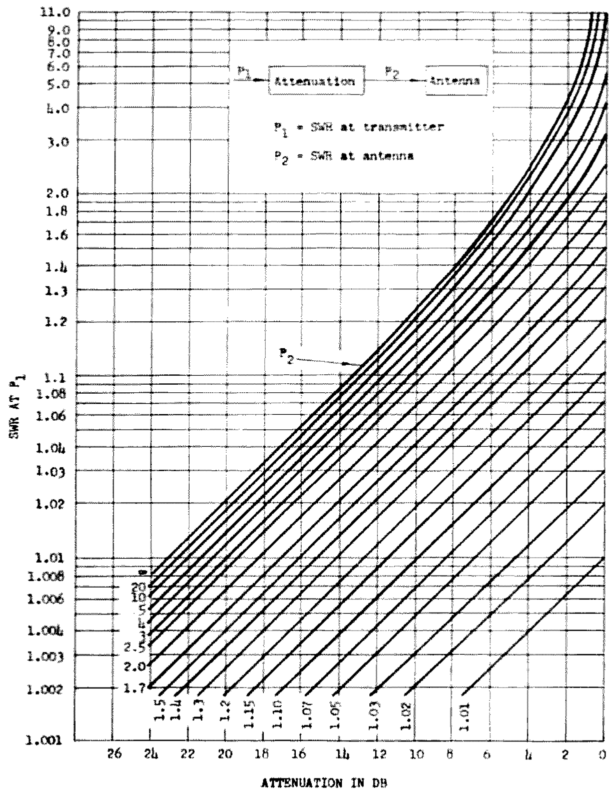


Figure 5

SWR vs attenuation.

For example, 143 feet of RG8A/U at 50 mc would result in approximately 2 db attenuation. If an SWR bridge inserted in the line at the transmitter indicated an SWR of 2:1, this graph shows that an SWR of 3:1 exists at the antenna. A look at Figs. 3 and 4 will indicate that a 3.3 db loss (2 db times 1.65 multiplier) occurs, amounting to 47% loss of transmitted power in transmission line losses. Of the remaining 53% power arriving at the antenna, 24% will be reflected back down the line. A little simple arithmetic will show that of the total power transmitted, only 30% will be radiated! This simple mathematical fact should make the merits of low standing wave ratios immediately obvious if we wish to get the most out of our equipment. By keeping transmission lines short and by insuring that the SWR is as close to 1:1 as practicable, line losses will be minimized, maximum power will be delivered to the antenna and more successful and reliable radio communications will result.

. . . WA6BSO

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Short Folded Dipoles

The conventional ½ wave folded dipole antenna has been used for a multitude of applications over the years. There are times however when space limitations require a radiator considerably shorter than ½ wavelength without compromising performance, particularly on the 3.5 and 7 mc bands. One answer to this problem is to use either a ⅜, or ¼ wave folded dipole configuration.

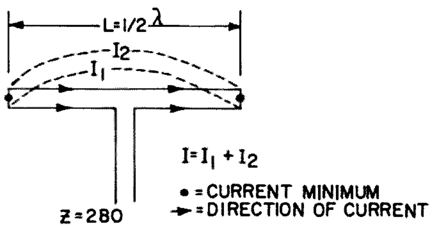


FIG. I CURRENT DISTRIBUTION IN 1/2λ FOLDED DIPOLE

The basic ½ wave two-wire folded dipole is shown in Fig. 1. When both conductors are of equal size, the currents in each are equal and in phase with each other. The impedance of this antenna is nominally 4 times that of a single dipole, or 280 ohms. If we add a third conductor in parallel, the impedance becomes 9 times that of the dipole, or approximately 630 ohms. Thus for a ½ wave folded dipole having all conductors the same diameter and equally spaced, the impedance step-up ratio is N^2, where N is the number of conductors.

If we use a shorter physical length than ½ wave for the folded dipole, the current magnitudes and phase relationships change considerably however. If we first consider the ⅜ wave configuration shown in Fig. 2, we

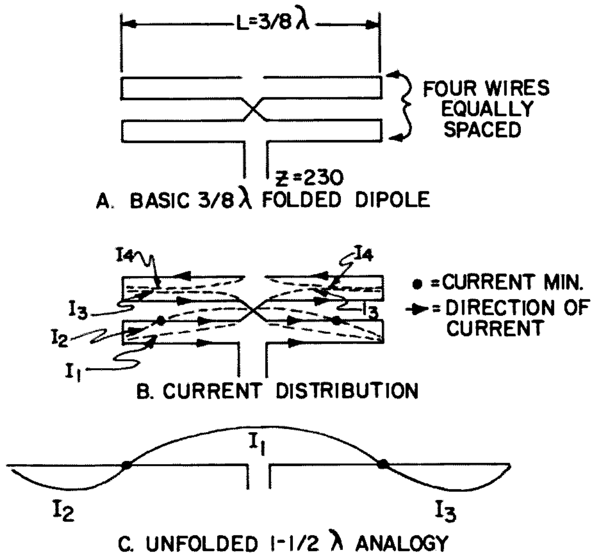


FIG. 2 THE 3/8λ FOLDED DIPOLE

find that the basic current distribution is the same as for an antenna 1½ wavelengths long, or the condition when a 7 mc folded dipole is resonated on 21 mc.

The analogy is not exactly true in this case however, as by folding the conductor back on itself we introduce phase reversals between the conductors, with their resulting additions and cancellations. The overall effect gives a total current in the antenna that is very similar to the one we find in a conventional two-wire folded dipole ½ wave long. The impedance step-up in this configuration is slightly over 3 times, and approximates 230 ohms. This is close enough to the 300 ohm value of common twin lead that the SWR is well below 1.5:1 for the ⅜ wave antenna.

Thus a ⅜ wave folded dipole for 7 mc is only 50 feet long, as opposed to 65 feet for the ½ wave version. The overall length could probably be reduced to 35 to 40 feet by drooping the ends without too much of a loss in efficiency if necessary.

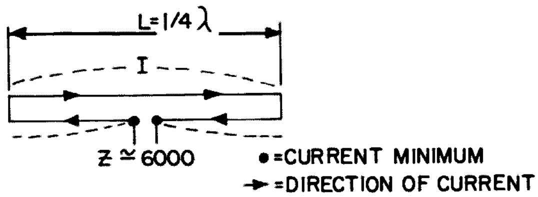


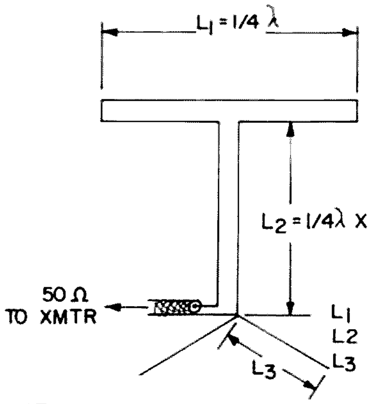
FIG. 3 THE 1/4λ FOLDED DIPOLE

Now for the ¼ wave folded dipole. How does it work? Well the answer to this is that the antenna is really ½ wave long. This can be seen clearer if we again consider the regular ½ wave folded dipole. In the ½ wave configuration the antenna is operating on its second resonance, or in actuality the current dis-

tribution is the same as for a full-wave antenna before we folded it to bring about a phase reversal.

The ¼ wave folded dipole then is equivalent to an end fed ½ wave radiator, operating on its first resonance. As the ends are folded back, the efficiency suffers a bit from out of phase current cancellation, as shown in Fig. 3. However, this normally only amounts to about 0.5 db loss in the system, and is a small price for shrinking the antenna 50% in overall length.

There is a sour note to this antenna though, which has discouraged many potential users. This is that the antenna exhibits a feed point impedance of around 6000 ohms, which certainly does not conform to our standard feed line impedances. This problem can be cured easily however by use of a ¼ wave matching transformer section. For a 75 ohm feed line, the matching section is 670 ohms. Similarly for a 50 ohm line it becomes 385 ohms, and conceivably could be made from either 300 or 425 ohm open wire TV line with a resulting low SWR.



DIM. IN FEET

	160/80	80/40	40/20
L_1	65	33	17
L_2	54	27	13.5
L_3	50	25	12

NOTE: 4 RADIALS ARE USED, MAY BE LAID ON GROUND OR BURIED.

FIG. 4 THE MULTEE ANTENNA

The ¼ wave folded dipole was used successfully in an antenna popular several years ago, known as the "multee". This antenna was fabricated from 300 ohm line for both the flat top and matching section, as shown in Fig. 4. The main feature of the "multee" was that it provided two band operation in a restricted space. On the lower frequency, the antenna functions as a top loaded vertical, while on the higher frequency it becomes a ¼ wave folded dipole, fed thru a matching transformer from a 50 ohm line. The use of radials at the base serve two purposes: first, to provide a ground return when the antenna is used as a vertical, and second, to de-couple the unbalanced/balanced effect of feeding with a coaxial line.

. . . W6WAW

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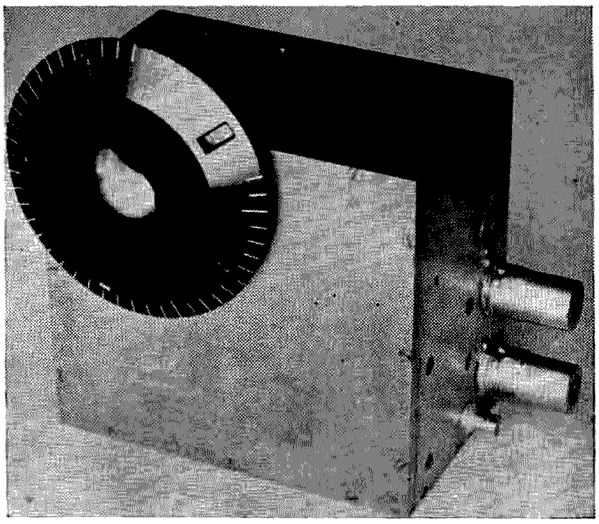
VFO Construction Techniques

Use of the variable frequency oscillator or vfo in amateur transmitters has a long and interesting history. The vfo goes back to the wide-open, breadboard construction of the MOPA transmitters used in the Twenties and the early Thirties. Improved circuits, better components and modern construction techniques have resulted in the present commercial availability of high performance oscillators. A good example of this development is the Collins Radio Company Permeability Tuned Oscillator (PTO). Highly stable and accurately calibrated, these units provide performance that would have been considered impossible a few years ago.



Amateur construction techniques have also improved and many fine vfo units have been described in the various amateur radio magazines and handbooks. Several "pet" circuits have been presented as providing the ultimate in stability. Other articles have stressed the requirement for sturdy mechanical construction. Obviously, any method of construction that will permit the movement or vibration of frequency determining components will result in undesired shifting or modulation of the output frequency. Despite the universal knowledge of this fundamental concept, many published articles describing construction of "high-performance" vfo's specify the use of light-weight, thin-gauge commercial cabinets and chassis. Inadequate mechanical design and the selection of inferior capacitors and inductors have contributed to the generally poor performance of many commercial and amateur constructed vfo's. Finally, the performance of a vfo can be no better than the performance of the tuning dial drive.

Almost any circuit will provide satisfactory performance if truly rigid mechanical construction is employed, high quality parts are used, a precision dial used and if the circuit is operated at low level with adequate isolation between the oscillator and the higher power transmitter stages. The wide variety of circuits used in the best commercially available equipment proves that no one circuit has a decisive advantage over others. All the better commercial units have one characteristic in common—they use the best available components and drives and they are built like a battleship.

The vfo shown in the photographs was designed and constructed along these lines. This vfo was constructed several years ago to prove to a Doubting Thomas (W4SYJ) that a home-brew vfo could be built which would equal the performance of the Collins PTO in the areas of stability and direct reading linear frequency calibration. Obviously, no restrictions were placed on size or weight. This unit, using the Colpitts circuit shown in Fig. 1, met these performance standards. This unit tunes from 3.5 to 4.0 mc in exactly 500 dial divisions of the surplus National PW series dial and capacitor assembly.

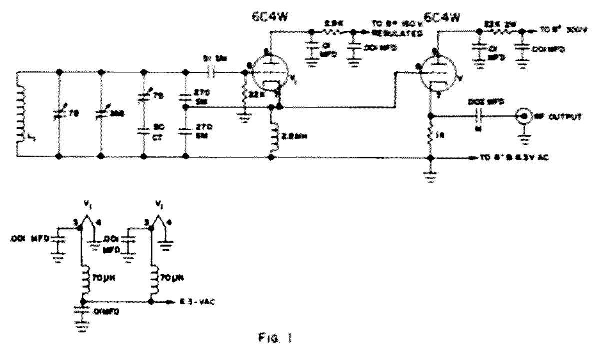
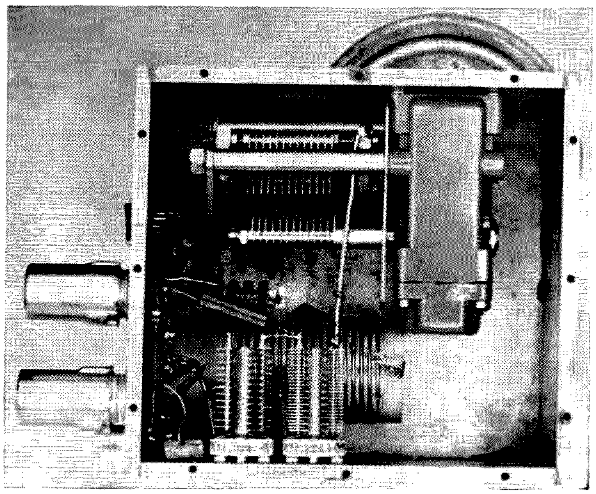


FIG. 1

NOTES:
1. Unless otherwise noted, all resistors are ½ watt composition.
2. Fixed capacitors designated "M" are mica, "SM" are silver mica and those not designated are disc ceramic. Capacitor Ct it N750 temperature compensating ceramic capacitor.
3. With capacitor values shown and L1 consisting of 10 turns on 1½" form, circuit tunes from 3.5 to 4.0 mc.

While few if any readers will attempt to duplicate this unit exactly, circuit and construction details will be discussed in sufficient

detail to permit inclusion of desirable design features in existing or future vfo's. For convenience, the circuit was lifted almost exactly from a commercial variable frequency oscillator, the Technical Material Corporation Model VOX. This circuit consists of a parallel-tuned Colpitts oscillator with a direct coupled cathode follower. The only significant circuit change was the use of a 6C4W in lieu of the 6C4 oscillator and the use of a second 6C4W in lieu of the ½ 12AU7 cathode follower. Plate and filament decoupling circuits were added to permit the use of an external power supply.



The enclosure for the vfo measures 6½″ × 6″ × 4¼″ deep and is made from six pieces of ¼″ brass plate. The front, back and sides of the case were rough-cut on a bandsaw and the edges squared on a shaper. Individuals interested in duplicating the enclosure may have the brass rough-sawed by a dealer and use a large mill file to square up the work. After the pieces are fitted, assembly is accomplished by drilling and tapping for 4-40 flat head machine screws. A total of 36 screws were used to assemble the enclosure shown in the photographs. Components were layed out and the various required mounting holes drilled. Larger holes were cut with a hole saw in a drill press. After all drilling and cutting was completed, the unit was disassembled and the brass sanded smooth. The brass was then silver plated, using one of the available "rub-on" silver plating compounds. The case was then reassembled. The result is an absolutely rock-solid enclosure that will not deform under any anticipated use condition.

Use of a precision dial and capacitor assembly is mandatory for good vfo performance. Use of a straight-line frequency capacitor is required if linear calibration is to be obtained. The National PW series of drive-capacitor units meets this requirement. Many of these units were available on surplus and may still be obtainable. If direct calibration is not required, units such as used in the BC-221 Frequency Meter are suitable. As a last resort, the drive and capacitor out of one of the Command Set receivers will provide acceptable performance. Next in importance is the use of a high quality inductor. The coil shown is a surplus unit consisting of 18 turns of #14, silver plated wire wound on a 1½″ diameter, grooved ceramic form. The coil was tapped at 10 turns to provide the desired frequency coverage. The unused portion of the coil caused no noticeable adverse effects. Use of such a coil, firmly mounted, is strongly recommended for vfo construction.

High quality parts are used throughout the vfo. Except for the temperature compensating capacitor, Ct, silver-mica capacitors are used in the oscillator circuit. The 75mmfd trimmer capacitors are silver plated brass units with locking nuts. All components are mounted using the heaviest permissible hardware. Wiring is all point to point and the largest size tinned solid wire that will fit the terminals of the various components is used. The 6C4W tubes are rigidly held in position by the use of ELCO heat dissipating inserts in the tube shields. The tube envelopes and shields thus become an extension of the massive case and relatively immune to vibration and shock.

Adjustment and calibration of the vfo will be dependent on the frequency coverage desired and the inductor and tuning capacitor selected. VFO calibration and adjustment has been described in the handbooks and in numerous magazine articles so the procedures will not be discussed here. The only departure from standard procedures is in adjustment of the temperature compensation circuit. Two trimmer capacitors are used. A temperature capacitor is connected in series with one of the capacitors to allow precise compensation for drift due to temperature change. Adjustment of the second trimmer allows the oscillator to be reset to the desired frequency.

Performance of this vfo is truly outstanding. The calibration is within three kc over the complete tuning range. With the dial locked in position, the unit may be picked up and dropped to the bench with a barely perceptible shift in frequency. After a ten minute warm-up, drift is so small as to be completely unnoticeable. Tuning is extremely smooth and reset accuracy is very good. The superior performance of the unit is directly attributable to the massive construction and the use of a high quality capacitor and drive. Battleship construction pays off . . . give it a try!

. . . W4WKM

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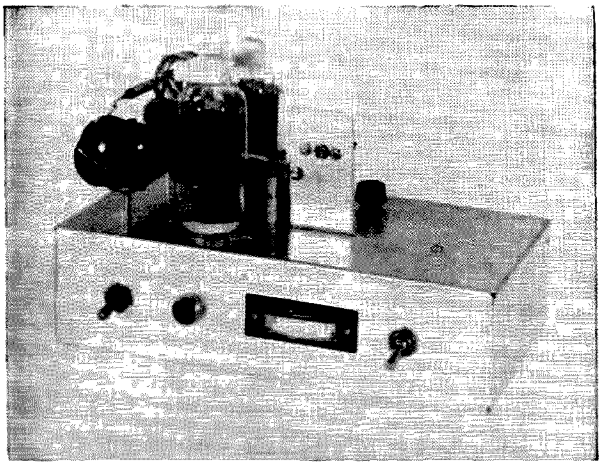
A 2 Meter Double-sideband Adapter

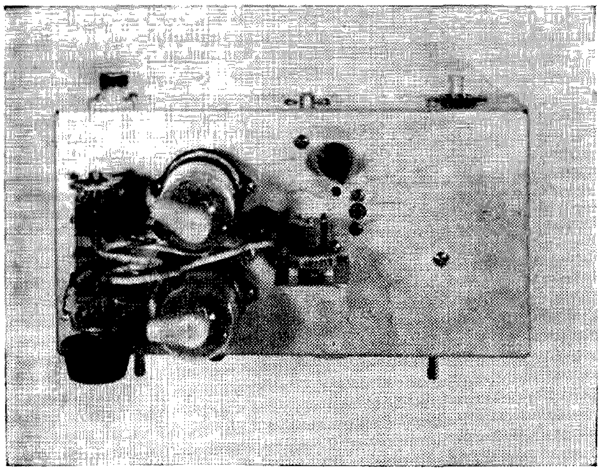
That single-sideband will eventually be the predominant mode of voice transmission for all amateur frequencies cannot be seriously denied by even the most staunch advocates of AM and FM. However, with many amateurs, like myself, double-sideband suppressed-carrier may well be the stepping stone to VHF SSB. If it is not a matter of laziness—or perhaps more correctly, a desire for simplicity of construction—it may also be an economic problem in which case DSB is ideal—if the amateurs on the receiving end will be tolerant of the fact that a DSB signal is often more difficult to correctly tune in than an SSB signal.

Before beginning the description of my two-meter DSB adapter, I must in all honesty, warn you that DSB (or SSB) contacts on two-meters may be not too frequent. You should not, at least at the present, disable your AM or CW equipment in favor of DSB or SSB. In fact, therein lies the beauty of this DSB adapter. It uses your existing two-meter gear and allows you to return to AM or CW operation quickly and easily.



2M DSB Adapter

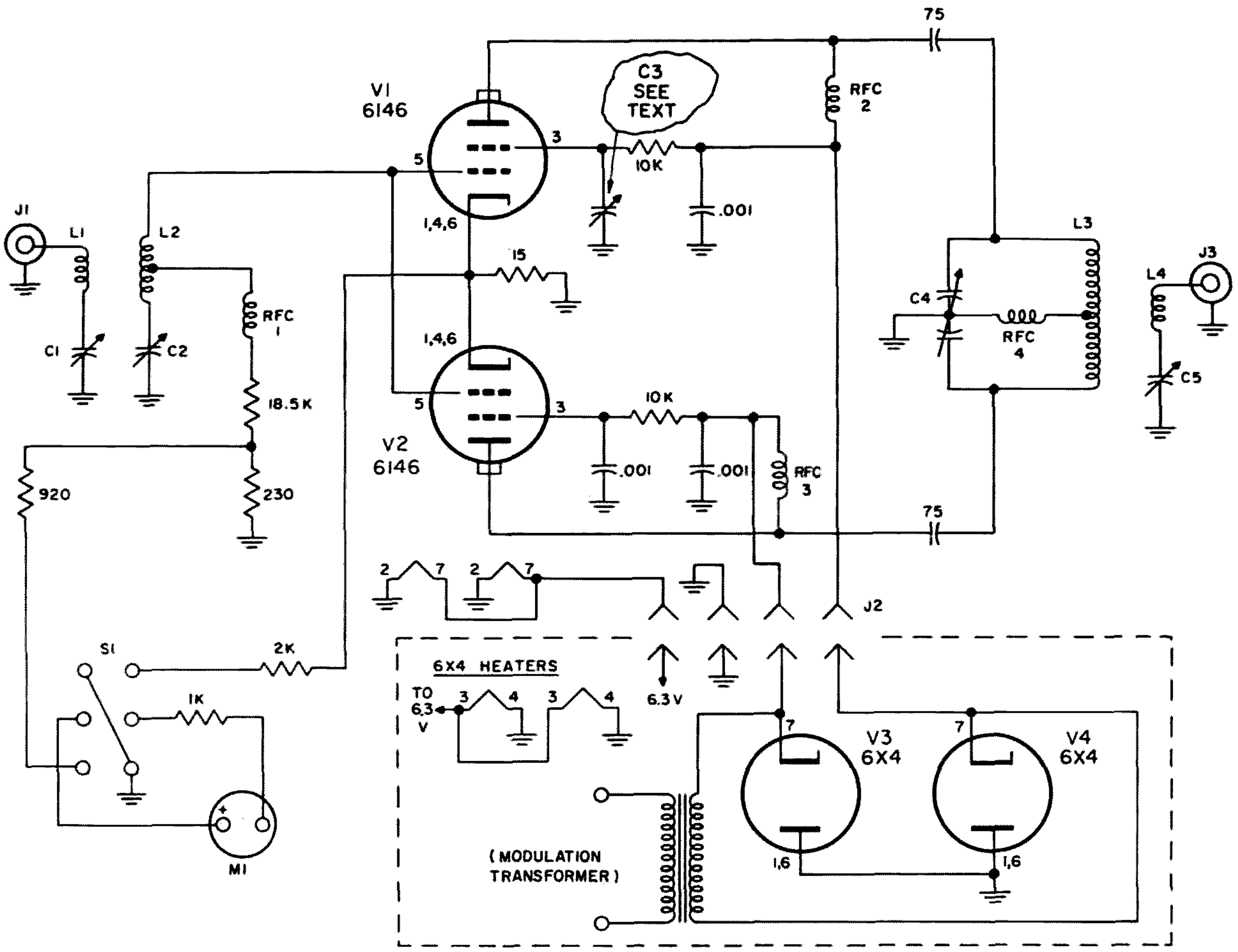
This adapter will have you on two-meter sideband with only a few hours of construction. It utilizes your two-meter transmitter as the source of rf drive. The plate and screen voltages for the 6146's are provided by rectifying the output of your existing modulator. No other high voltage is supplied to the adapter. The adapter shown in the photographs uses 6146's simply because I had them on hand. For the power level achieved with this system a more economical approach would be to use a pair of 2E26's, or for lower power, a pair of 5763's. It should be stressed that twin-tetrode tubes (such as the 832, 832A, 829B, 3E29, and 6360) are not suitable for this application since the screen grids have a common terminal and hence cannot be used in this push-pull-output circuit.



Top View

The rectifiers V3 and V4, rectify both positive and negative voice peaks and cause audio voltage to be applied to the balanced-modulator 6146's. When the top end of the modulation transformer secondary goes positive, the plate of the top 6,146 (VI), is driven positive, and the ground return circuit is through rectifier B4. On negative voice peaks, when the bottom end of the secondary goes positive, the plate of the lower 6146 (V2) is driven positive, with the return through V3. Positive voice peaks thus supply plate and screen power for the upper 6146, and negative voice peaks supply the power for the lower 6146.

A balanced modulator results when we have (as shown in the schematic) the grids of the tubes in parallel and the output circuit in push-pull. Applying audio voltage alternately to the plates and screens of the 6146 balanced modulators results in a carrierless double-sideband signal. A small advantage of this circuit is that, since only one tube works



at a time, the non-conducting tube is an effective "neutralizing capacitor" for the other tube.

Reports on audio quality with this adapter have been quite good, and we believe that the plate-and-screen modulation is part of the reason for these reports. As you know, most high-level double side-band transmitters utilize screen modulation which, when not properly adjusted, often results in less-than-the best audio quality.

The modulator used with this adapter is designed to limit the audio frequency response by using .002 coupling capacitors, a 100 mmfd capacitor across the microphone input, a 470 mmfd capacitor across the grids of the 807 modulators, and a .002 capacitor across the secondary of the modulation transformer. Too many lows in a double-sideband signal result in increased difficulty in tuning in the signal, and a strange "growling" sound.

The 6X4 rectifiers were chosen after making comparisons with silicon rectifiers. So little difference was noted in this application between silicon and tube rectifiers, that it was decided to stay with the 6X4's since they have a peak inverse voltage rating of 1250 volts, a peak current rating of 210 ma, and cost about 90c each. Silicon rectifiers of equivalent PIV and current ratings are far more expensive. The 6X4's should be quite adequate for use with modulators having a power output in the vicinity of 100 watts. Silicon rectifiers can, of course, be used if you prefer.

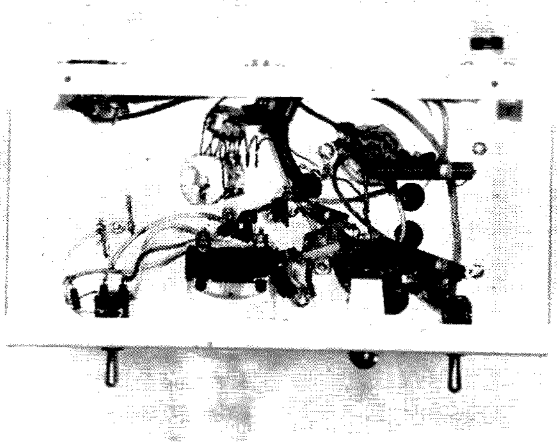
You will note that the screen resistor value is lower than customarily used with 6146's or 2E26's. Don't let this frighten you because the tubes operate on a very low duty cycle in this application, and can easily stand the increased screen voltage and resulting greater plate current. The heavier plate current thus drawn also offers a greater load to the modulator, and in my case, resulted in better

Parts List

C1—7-7 mmfd air variable capacitor
C2—5-50 mmfd air variable capacitor
C3—Mica trimmer capacitor, 7-40 mmfd (see text)
C4—HFD-15X (Hammarlund) dual variable capacitor; four rotor plates removed from each section; no stator plates removed.
C5—5-50 mmfd air variable capacitor
J1—RCA-type phono jack
J2—Four-contact Cinch-Jones #S-304 socket
J2—UHF-type coaxial panel-type connector
M1—0-1 ma meter, Shurite Model 350 "edgewise" type
RFC1, 2, 3, 4—Ohmite Z-144 rf choke
S1—dpdt switch
V1, V2—6146, 2E26, 5763, etc. (see text)
V3, V4—6X4

sounding audio than when screen resistors of more conventional values were used.

The meter is an inexpensive Shurite "edgewise" Model 350 0-1 ma meter. It is quite adequate for the application, and, incidentally, is surprisingly accurate for such an inexpensive instrument. With the resistors shown in the schematic, the meter reads 10 ma full scale in the "Grid" position, and 200 ma in the "Cathode" position. Remember when reading cathode current you are reading both plate and screen current.



Bottom view

A means of balancing out the last trace of carrier is highly desirable in any SSB or DSB transmitter. I found that in this adapter the carrier could be nulled out by using a 30 mmfd maximum trimmer in place of the usual .001 mfd screen bypass capacitor for *one* of the 6146's. There was a sufficient difference between the two 6146's that by placing the trimmer capacitor from the screen grid to ground of first one tube and then the other, I was able to find the tube with which the trimmer would null out the carrier quite nicely. A .002 mfd capacitor is connected from the other tube screen grid to ground.

The unit shown in the photographs was experimental, to determine if this system was feasible on two meters. As a result, several things would be done differently if I were to do it all over again. First, the grid input circuit should be arranged so that the coils and capacitors are closer to the grid connections of the tube sockets. Secondly, the output circuit of the tubes should be similarly arranged closer to the plate caps. You will note that there is an unused switch on the front of the chassis; this was installed during experiments to determine if the circuit could be sufficiently unbalanced to allow AM operation. To date, this has not been possible with any degree of audio quality.

. . . W6TKA

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When Good Losers Get Together . . .

Mortiz (WA5EFL) who hobbies around with mechanical engineering in his space time, got into one of those Sugar Bowl games of chance with ham radio operators from a half-dozen other states. It started in the pre-game gab. Moritz naturally knew that Arkansas was going to whip the pants off of Ole Miss. Alligator Bill (K5SQS) over at Alligator, Miss. was just as certain the Rebs would win. Others joined in.

Before the kick-off, about fifty hams were in on an agreement, which, although it certainly was not gambling, would see all the losers send $1.00 to the winner.

To explain the procedure, so that nobody will get the idea there was any gambling—far be it fromthat!— all the hams had one fairly trustworthy fellow over at Memphis, Bill (W4IIY) draw for them out of a hat.

What he drew for Alligator in Mississippi, for a ludicrous example, was a number indication that the Rebels would defeat Arkansas by four points. What he drew for Moritz, for another example, was that Arkansas would flail Mississippi by twenty-two points.

If we remember the final Sugar Bowl score—it was 17 to 13 for Alligators Ole Miss team.

Despite this flukey outcome, Moritz sent his buck and a second one for his Dad, who had also become involved, over to Alligator. Actually, he didn't just put a couple of bucks into an envelope. First he had them changed into 200 pennies. Then he whipped up a mixture of sawdust, graphite and heavy duty motor oil and stirred the pennies up in it. Then he constructed a box about three inches by three inches and spooned the money mixture inside. He sealed the box with glue, cleats, nails and everything else in sight. Around this he constructed another box of the same description. It fit like plywood on the first, which gave the good loser another idea; a third layer. This was so satisfactory it called for a fourth.

When the project was finally finished several hours later, Moritz had put together a dandy little container that Alligator could open any time he could find a jackhammer and a couple of days off. Meanwhile, throughout surrounding states, other good losers were graciously settling up. Another sent a check made payable to Alligator for "The Football Swindle".

Moritz's little package (sixty cents for mailing) arrived with a cluster of these pay offs. Alligator took it down to his basement hamshack and attacked it with a hammer and screwdriver—two ridiculously ineffective devices. From that he turned to hacking and sawing and kicking and loudly reciting garbled call letters. Finally Alligator got a hole through all the layers, which enabled the oily sawdust mixture, but none of the money, to spew out on the floor.

The XYL didn't think this was so funny. They say that hams clear out in Oklahoma who didn't even have their sets on could hear her laying into Bill. So he had to get back to Moritz. Alligator got on his radio and called Harry (W5HFQ). Making sure Moritz was not on frequency, he then asked Harry to call Moritz in Little Rock and report that Alligator had cut his finger trying to open a crazy box of some sort.

This was a good plan except for two reasons: A local ham overheard the plot and let Moritz know immediately. And also no one else on the frequency got in on the fact that it was a hoked up story. Each telling magnified the story and by the time it had circulated through six states, Bill (W4IIY) heard that Alligator was on the verge of losing an arm over some freak accident. Being close personal friends, he called Alligator long distance to check on his critical condition.

"Even if he lives through it, they'll send him to prison," Moritz said cheerily. For Bob (K5KMK) who is a banker, made his check payable to Alligator but neglected to sign it. Alligator informed Bob on the next QSO about this matter. Bob was all apologetic and said, "You just go ahead and sign my name, Alligator, and I'll clear the check when it comes through."

Bob is waiting on this evidence to clear so he can hold Alligator for check forgery.

This just goes to prove that you can't win them all!

. . . WA5EFL

In the market for a new receiver? This article will help you decide which to buy.

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Evaluating Receivers

About ready to replace the tired old receiver in your shack, with either a new or "like-new" one? Or thinking of adding a second one for standby?

Either way, you won't want to make the acquisition blind—unless you happen to be the rare type who prefers to purchase his pigs in pokes. Most of us at the very least like to read over the specs of a receiver before buying it.

But the "like-new," as well as the "surplus-bargain" variety, won't have a specification sheet with it unless it really did belong to a little old lady from Pasadena who only used it to listen crosstown on Sunday afternoons. And even then, you might like to know just what shape the frailly feminine previous owner left the rig in.

Here are some tips on receiver evaluation, based in part on typical checkout tests and in part on years of experience in receiver trading (and years of getting lemons until some of these tricks were learned).

The first step is, of course, to turn it on and connect an antenna. If you can't do that, any purchase will have to be on the basis of "caveat emptor" and brother, you'd do well to caveat!

With the rig warmed up, tune in a weak and known stable signal. WWV will do nicely, as will a harmonic of the 100-kc calibrator if available. Next, lift the receiver lid and let it drop a couple of times. This is just a warm-up to see if the receiver is really unstable; for the real test, turn on the BFO and adjust it for as low a beat note as you can comfortably hear. In any event, it shouldn't be much above 100 cycles. Then drop the lid again and listen for any trace of warble.

This is a tough test; as little as 50 cycles change in either local oscillator or BFO frequency will show up as a one-octave change in beat-note tone! If you get no warble when the lid is dropped, pound the side of the receiver gently. Do not, however, drop it 5 feet onto a concrete floor. It might dent the floor.

Assuming that this test is passed (and fully half the receivers around may flunk out right here) open the lid and blow across the tuning capacitor. If it's buttoned up tight in a shield box, blow across the oscillator tube. Again you don't want to hear any warble, but you quite possibly will. At least one highly regarded current-production receiver flunks on this one. The real question, of course, is does the warble sound suspicious enough for you to say "No, thanks" or does it appear to be within bounds—and only your own insistence on perfection will supply the answer to that.

Now that we've established that the receiver has frequency-meter stability—and if it passes both the preceding tests, it does and then some—we can check the selectivity. You can use the WWV signal for this, but a rocking 50-kw broadcast transmitter or California kilowatt is better. Tune across it and note how wide the signal appears to be.

To be more scientific about this, you might hook up a signal generator and tune its signal in. Adjust generator output until the signal registers 20 db over S9 when tuned for maximum strength. Then tune across it, and note how many kc it is between S2 on one side of center and S2 on the other; this will be your approximate 60-db bandwidth. Reduce signal generator output until you have a peak reading of just S9 and note the width between S8 points; this is the 6 db bandwidth. Dividing the 6-db bandwidth into the 60-db bandwidth will give you a shape factor, which may turn out to be nice to brag about if you buy the unit.

But for an in-the-store examination, the BC station will do as well; if it takes out some

40 kc or so of spectrum, the selectivity is not good. If, on the other hand, the BC station starts sounding like SSB when you're off-tune just 3 or 4 kc either side, the selectivity is very good indeed.

To check out a crystal filter, do the same thing. In the maximum-selectivity position of the crystal switch, the signal should have a distinct ringing sound. Many older receivers which are out of adjustment or have defective crystals won't produce this ringing.

To make a check of sensitivity, remove the antenna. See if you can peak up the receiver noise with the antenna trimmer, with the antenna disconnected and the bandswitch set to 10 meters. If you can't, the front end is pretty poor. If you can, put the antenna back on and if possible switch to 11 meters. The 5-watt wonders there provide an almost ever-present source of weak signals so you can tell where noise leaves off and signal begins.

So far as other controls are concerned, you will probably have twiddled them all in the course of performing these tests. Any sputterings or pops from the speaker with rotation of a gain control indicates probable trouble in either the control involved, or the circuits associated with it. Jerky tuning will make itself obvious in the selectivity test as an inability to find the S2 points accurately.

The noise limiter may not have received a good workout. Fortunately, most ham stores are located near busy streets and many cars still have unsuppressed ignition systems. A rough check of ANL action may be made simply by switching it in and out while checking on-the-air sensitivity.

Should you live near a powerful transmitter other than your own, cross-modulation might be worth checking into. This will require a modulated signal generator, which may not be available in the store. Set the signal generator for maximum output. Tune to a fairly weak (S4 or S5) signal on your favorite band. Set the signal generator to approximately the same frequency and tune the generator back and forth. If you hear the 400-cycle modulation from the generator on the weak signal, tune the receiver to the geneator frequency. If the frequency is very close (50 kc or less) the effect is normal and to be anticipated. If it happens to be a possible image response, it should be considered as one. But if the modulation shows up whenever the signal generator is on, then you have cross-mod problems which are going to have to be cured if that receiver is to be usable.

If, like most of us, you tend to be a bit on the lazy side then you'll certainly want to check the avc action. This divides into two real parts: one is the avc characteristic on CW and SSB, while the other is the simple question "does the avc work right at all?"

Older receivers for the most part make little or no provision for avc when the bfo is on, and many even gang the switches so that avc is always off when bfo is on. In these, obviously, no use of avc for CW or sideband is going to be possible without some major receiver changes. In newer ones, though, you can get a pretty good idea by tuning to a medium-speed CW signal on whatever band is coming in best at the moment, and listening for "thumps" and apparent chirps on the beginning of each character. If all is well the thumps and chirps will be absent, yet the background noise will rise between characters. In some units, background noise will stay down—and this is a matter of preference. Most CW ops like to have it come back up in a hurry so they can work break-in easily, while the SSB gang likes to have it stay down between syllables but come back up quickly at the end of a phrase.

For a general avc test, turn everything but the audio up to maximum and tune in the strongest broadcast signal you can find. If anything is going to clobber the avc, this will be it—and BC stations are required by law to keep their audio pretty clean. Thus by simply listening for distortion while cutting back the rf gain you can find out if the avc is working. If distortion disappears suddenly as rf gain is reduced, something's wrong in avc!

Those of us who anticipate spending long hours at the rig have two "must" items for checking, unless we like to resemble the morning after the night before, following a 3-to-4-hour session on the air. These "musts" are power-supply hum, and audio distortion.

Neither of these possible defects is particularly objectionable during short sessions, but after some 90 minutes of listening to a background of raw ac the temptation to take up philately becomes strong!

To test for hum, plug in a pair of phones and turn the af gain all the way up. Turn rf gain fairly well down, and tune off signal. Listen for any hum. Some will undoubtedly be detectable, but the question is whether it's loud enough to be objectionable.

To determine whether it's the power supply or possibly a poor tube, turn the af gain down while listening. If hum goes away, it's originating ahead of the af gain and the power supply is probably pretty clean. Possible culprits are bad rf or *if* tubes, or a single poor filter capacitor. If, on the other hand, it goes

up, then the power supply is at fault.

Audio distortion is most readily checked by comparison against a known good receiver, but this may not be possible. Next best way is to repeat the general avc test but turn rf gain down and set audio gain wide open. If distortion shows up, reduce audio gain and see if it goes away. At the same time, compare to all

TEST	BANDSWITCH	RF GAIN	AF GAIN	SELECTIVITY	AVC	CALIB	ANL	BFO	ANT	RESULT
SENSITIVITY	10 Meters	Max	Any	Widest Band	Off	Off	Off	Off	None On	1 2
STABILITY	10 Meters	Max	Any	Any Setting	Off	On	Off	On	Any	3
SELECTIVITY	80 Meters	Max	Any	Approx 6 kc	On	Off	Off	Off	On	4
XTAL FILTER	80 Meters	Max	Any	Narrowest	Off	On	Off	On	On	5
ANL	10 Meters	Max	Any	Widest	On	Off	Off On	Off	On	6 7
AVC ACTION	Best Band Broadcast	Max	Any	2 to 6 kc	On	Off	Off	On Off	On	8 9
Power SUPPLY	Any Band	Any	Max Min	Any Setting	Any	Off	Off	Off	Any	10 11
AUDIO QUALITY	Any Band	Any	Max	Any Setting	On	Off	Off	Off	On	12
ALIGNMENT	Repeat Test 1 at each end of each band covered									13
TUNING RATE	Best Band	Any	Any	2 to 6 kc	Any	Off	On	On	On	14

Test Procedures and Results

1—Peak antenna noise with antenna trimmer, with no antenna connected. Failure to find noise peak indicates poor sensitivity.

2—When antenna is connected (noise still peaked) noise level should rise. Failure to find noise rise indicates poor front end.

3—Tune calibrator signal for 100 cps beat-note. Lift and drop lid. Warble in beat-note indicates poor mechanical stability. Blow into tuning-capacitor compartment. Warble in beat-note indicates poor temperature stability. Attach "Variac" in power line and vary line voltage. Warble in beat-note indicates poor line-voltage stability.

4—Tune across strong signal; note apparent width of signal between S2 points. This is approximately 60-db bandwidth of receiver.

5—Tune calibrator signal to peak of crystal-filter response. Zero-beat BFO. Tune slowly either side and look for notch. Check to see that phasing control moves notch position to either side of peak. Failure to find notch indicates poor alignment of crystal-filter circuits or defective crystal.

6—Check loudness level of ignition noise from passing cars. When particularly loud one approaches, proceed to test 7.

7—Check to see how much ANL reduces level of ignition noise. Do not expect much in reduction of neon-sign noise or QRN.

8—Tune to strong CW signal about 15 to 25 WPM. Listen for "thumps" at beginning of each character. Noise should rise between characters but no signal should overload receiver. This test is applicable only to newer receiver models.

9—Tune to strongest available signal and listen for audio quality while reducing RF gain control. Audio quality should not change as RF gain is reduced. Any fuzziness of audio which disappears as RF gain is reduced indicates insufficient AVC.

10—Use headphones; listen for power-line-frequency hum. Level of hum should not be objectionable; some is permissible.

11—If hum disappears when AF gain is reduced, it originates ahead of gain control. If level remains constant, insufficient power-supply filtering is indicated.

12—Tune in strongest available signal and reduce level by RF gain leaving AF gain wide open. Listen for any trace of distortion or fuzziness. Compare to other receivers on same signal at same time. Distortion indicates high IM, which results in extreme listener fatigue during contest operation, etc.

13—Repeat Test 1 at each end of each band; failure to achieve noise peak at each end of band indicates receiver is out of alignment on that band. Defect is not serious but should be considered as alignment can be a tough job with some receivers.

14—Tune in SSB signal. Note whether it is easy to tune, "sliding in," or comes in quickly and jerkily. Tuning rate is matter of personal preference; most like it slow, however, for easy SSB tuning.

other available receivers for distortion. If possible, compare against a Collins 75A4; this has about as little audio distortion as any receiver tested in our experience (but steer clear of S-line!).

Alignment of the receiver can be checked by repeating the sensitivity test at each end of each band; if you can't peak up front-end noise without the antenna, or if noise doesn't increase when the antenna is connected, the receiver is not properly aligned at that point. Most used receivers, unless they have just been reconditioned, are not in proper alignment; putting them back in isn't difficult but it may be time-consuming, especially if you don't have the instruction manual and have to figure out which slug or timmer controls which circuit on which band. It's something to keep in mind while dickering.

Dial calibration can be checked with a 100 kc calibrator; like alignment, it's not hard to restore but may take some time. Frequency readout from the dial is another matter. If you like to know the other fellow's frequency to the nearest cycle, you're not going to be happy with a dial in which the marks are 1/16 inch apart and each of them indicates 50 kc segments! While it's more a matter of personal preference than anything else, don't forget to take a look at the dial calibrations. The Collins line, of course, has virtually frequency-meter readout; many other makes approach this ease-of-reading condition. A few, however, do not. Check before you buy.

If your line voltage fluctuates widely, you'll want to run all of the tests at three different line-voltage conditions. One, of course, is at normal rated voltage. The other two are 10 to 15 per cent above and below normal, respectively. A Variac or similar adjustable autotransformer is handy, or you can put together a "voltbox" for such testing. The stability tests, in particular, may be severely affected. Distortion may also suffer at low voltage.

To make all this a little simpler and clearer, we've whipped up the accompanying "Receiver Checklist" which summarizes the tests, positions of receiver controls for each test, and test procedures and expected results. With it, you can pull a complete analysis of any receiver in a very few minutes. You can also check out the big station rig, to find out if it's still doing its best. Some top DX hounds check the receiver out thoroughly every 30 days, on the theory that a few minutes spent checking is more than paid back if any defect which might make them miss that rare one shows up. Try it. You may be surprised!

. . . K5JKX

Bill Reynolds K2ZEL/8
56 East Woodruff Ave
Columbus 1, Ohio

The RK 715-B on 6 Meters

The RK 715-B is a tube which has been by-passed by amateurs because of its filament voltage and the lack of specifications in recent handbooks. The tube is an indirectly heated tetrode originally designed for pulse service in early sonar and radar equipment. It requires 26 to 28 volts for the heater, 1500 vdc for the plate and 300 vdc for the screen grid. With a grid drive of 15 milliamps in class "C" service the amplifier will provide 500 watts input at six meters. The plate of the 715-B operates under these conditions with a slight tinge of red.

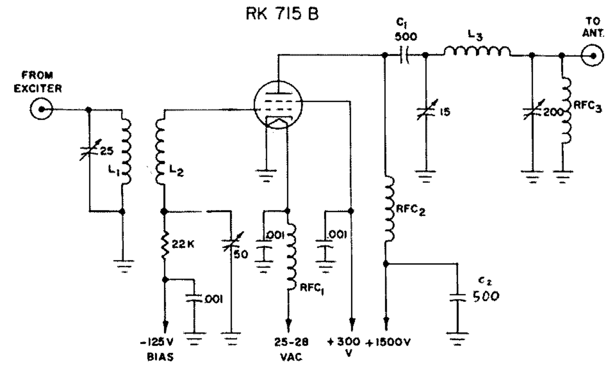


FIG. 1

RFC_1 10 turns #22 enamel close wound
RFC_2 42 turns #22 enamel close wound on ½" ceramic insulator 2" long.
RFC_3 ohmite Z-50 or equivalent
L_1 4 turns #18 ½" dia. close
L_2 8 turns #18 ¾" dia. close
L_3 4 turns 3/16" copper tubing, 1½" diameter, 1½" long
C_1, C_2 500 pf 20 kv TV doorknob type ceramic

Measuring the input capacity between the cathode and grid reveals that the old handbook is correct in listing a value of 30 mmfd. Because of the large value it is necessary to use an unusual grid circuit to permit tuning to the six meter band. The result is an inexpensive half gallon which is compact and easy to build.

1. The filament is heated by two 12.6 volt filament transformers with their primaries in parallel and the secondaries in series, making it unnecessary to search for a hard-to-get special 28 volt transformer from surplus.

2. The amplifier is built on a 6x9 chassis following the usual layout for a final. Bias may be provided by any number of circuits and is set at 125 volts negative to insure that the amplifier is cut-off when no signal is applied.

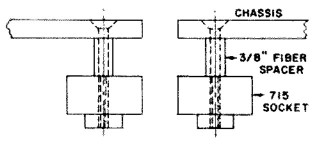


FIG. 2

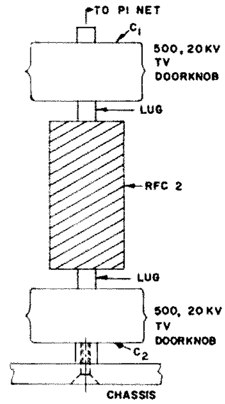


FIG. 3

3. The tube socket is recessed with ⅜" fiber spacers. This procedure permits the amplifier to self neutralize at six meters with no difficulties. If mounted on the chassis the circuit becomes almost impossible to neutralize. (see Fig. 2)

4. The grid is series tuned, permitting the amplifier to be tuned to six meters. The input coil is close coupled to the grid coil for maximum drive.

5. The plate choke is wound on a half inch ceramic insulator two inches long with the TV doorknob capacitors threaded into the ends of the insulator and then bolted to the chassis. (see Fig. 3) The plate cap is of the heat radiating type and the straps from the cap to the choke are either ¼" braid or flexible strap.

6. The Pi-net capacitors used at K2ZEL came out of a BC-191 tuning unit. The final has been used here for four years and, from reports, puts out a nice wallop. It is easily switched out of the line-up when going from ground wave work to local rag-chewing.

. . . K2ZEL

New Product

New 1965 Heathkit Catalog

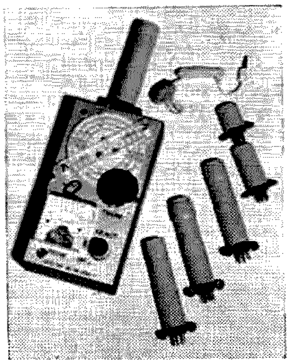
The new 1965 edition of the Heathkit catalog, illustrating over 250 easy-to-assemble electronic kits, is now available free upon request from the Heath Company, Benton Harbor, Michigan.

This 108 page kit-builder's treasure, with 16 pages of beautiful full color, boasts a kit for every interest, every budget. The catalog represents Heath's biggest kit offering yet, and features many new products including a bounty for the ham. New amateur products from Heath will make you drool.

The much-acclaimed Heathkit SB amateur radio series now hosts a new KW linear amplifier. A new speaker for mobile operation, and a new "Ham-Scan" Spectrum Monitor that adds sight to the sounds of ham and CB communications are also shown.

A post card or note with your name and address is all that's needed to get your free copy. Write the Heath Company, Benton Harbor, Michigan 49023.

New Product

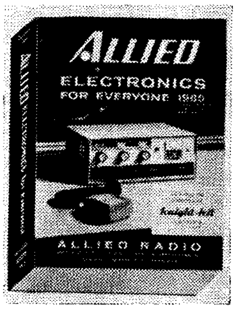


Quement Dip Meter

Any ham who builds his gear (or fixes it) needs a grid dip meter. And no ham wants to bother with a tube type GDM any more. The slow warm up and cumbersome line cord are a nuisance. Not to mention the high output which can blow out transistors. But Quement's new GDM-3 all-transistor dip meter eliminates these problems and provides a host of unique features as well. It operates immediately (and on a cheap 9 volt battery). It covers 500 kc to 150 mc. It's very compact and light. It's accurate and stable. It's well built and has vernier tuning. The coils are coated with a sturdy epoxy. An earphone is included for monitoring and frequency measuring.

One of the outstanding features we found on the one we received for test is the very strong and accurate dip. We were able to get two deep dips about one megacycle apart in a bandpass coupler at 50 mc. Another dip meter only shows one broad dip in the same circuit—and it has to be very closely coupled to get that! The sensitivity control needs very little adjustment when changing frequency, too. It's quite a gem and the price is only $29.95. Be sure to drop some hints—it would make a mighty nice gift for Christmas.

New Products

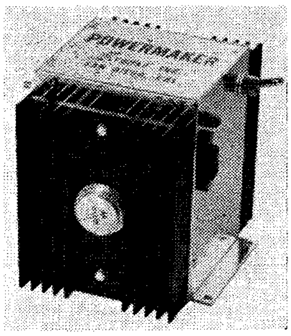


1965 Allied Catalog

Allied's 1965 catalog is now available. Marking the company's 44th year, the new 490-page catalog presents the greatest selection of ham equipment in the company's history.

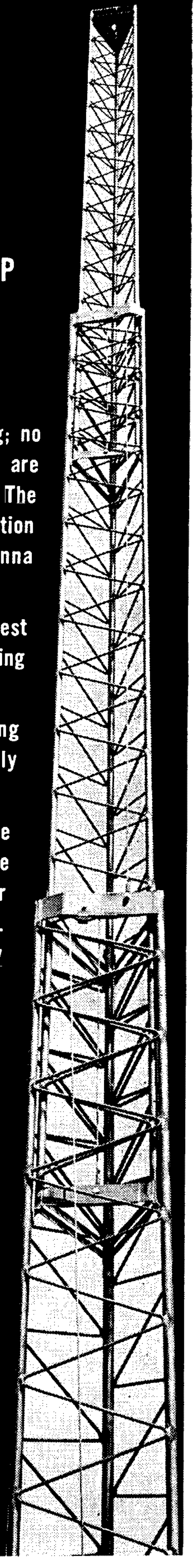
Space devoted to transceivers and VHF gear has been greatly expanded. The new products in the lines of the leading manufacturers are illustrated and described in detail. There are feature-packed transmitters, new single sideband transceivers, VHF equipment for 6 and 2 meters, linear amplifiers, transmitting and receiving antennas, towers, mobile antennas and accessories, code practice aids, ham station clocks, crystals, adapters, TVI filters, coaxial cable and every kind of ham station accessory. The catalog also lists thousands of other electronic products produced by hundreds of manufacturers.

The 1965 catalog #240 is available free on request from Allied Radio Corp., 100 N. Western Ave., Chicago, Illinois, 60680.



Powermaster Inverter

Topaz has announced their new Powermaster 300 watt inverter. It changes 12 volt dc from your car battery to 110 volt 60 cycle power. Because of its high power rating and high efficiency, it can operate most ac ham equipment directly and economically without the necessity for a special dc power supply for each piece of gear. The Powermaster is very compact (only 5⅜ x 5⅜ x 5⅜ inches) and weighs but 12 lbs. It comes complete with all cables and instructions. Available from the factory or from distributors. Price: $44.95 plus shipping.



Testing the Venus di Clegg

Back last spring, when we were getting 73 Mountain ready for the big June VHF scramble, there was considerable discussion over which rigs were best for which bands. Everyone agreed that, if we could get it, a Clegg Venus would be the last word for our six meter effort.

Somehow I managed to talk Clegg into sending one up on loan. When it arrived everyone was so anxious about it that they had it unpacked before the carton ever got off the delivery truck.

What a beauty!

I could see that nothing further would get done on 73 if I left it around here, so I drove it on up to the mountain, plugged in the ac, the mike, and an antenna and started talking to the growing mob of sidebanders down at the low end of six. I found I was getting out so well with the Venus that it was hard to tell if the band was open or not.

While the AM boys were fighting RM and changing band conditions I found that I could have long rag chews with sideband stations. VP7CX, who, by the way, has a Venus and is wild about it, called me one day and we talked for about a nhour. He has been carrying on daily skeds with Panama and crazy things like that which no one would even have considered before the advent of sideband on six.

One fellow called in and said he had been considering a Venus, but that the transceive type of operation worried him. He wanted to be able to tune his receiver separately from his trasnmitter. I pointed out how simple it was to feed the 14 mc output of the Venus' converter to his regular station receiver and use that for tuning off the transmitter frequency. In this way you get all the extraordinary sensitivity of the grounded grid nuvistor converter in the Venus as well as its stability (it *has* to be stable to be good for SSB).

Tuning the Venus is a dream. Those Eddystone dials may be expensive, but they sure are worth it.

Since a lot of the six metter gang still are using receivers without bfo's, it is handy to be able to switch to the AM position at times. The receiver has both AM and SSB detectors, switchable AVC and a very effective noise limiter. The Venus was able to give perfect copy of signals under QRM conditions that just about stopped every other receiver we had

available. Between a two meter kilowatt in the next room and a six meter kilowatt on a nearby mountain top, the pressure was really on.

Grid block keying is used on CW, though we only were able to make a few contacts on this mode. There sure isn't much CW activity in that bottom 100 kc, even when the band is open. If it ever developes, the Venus will be ready for it.

The Venus kicks up to 85 watts PEP (all modes), which is plenty for most operation. If you want to always be first there is a nice linear available from Clegg, the Apollo, which plugs right into the Venus and boosts you to 700 watts.

The Venus normally tunes from 49.975 to 50.475, though it takes just a quick crystal replacement to change this range to any other 500 kc you want to tune. Since the great bulk of six meter activity is in the lower 500 kc this will hardly ever cause much of a problem . . . and if you stick to sideband, which is almost completely between 50.1 and 50.2, you'll never know there is part of the band you're not using.

The stability of the Venus is attributable to the carefully built 5.0 to 5.5 mc oscillator. This is mixed with the 14 mc output of the converter to give a 9 mc signal which is fed through the 9 mc crystal filter and results in 3 kc selectivity. The final *if* is 450 kc. The transmitter heterodynes the 14 mc signal up to 50 mc with a 6883 (twelve volt 6146) in the final. The unwanted sideband is down over 50 db at 1000 cycles and the carrier is suppressed more than 56 db. Distortion products are down over 30 db at full output. Since all circuits except the final are broadbanded the tuneup process is simple. Even the final doesn't have to be touched for small frequency changes (say 100 kc or so).

During the two months that I used the Venus I worked 43 states, VE1-2-3-4, VP7, and CO2. What a world of difference there was using this rig as compared to a small AM job! . . . Staff

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SSB with the 6N2

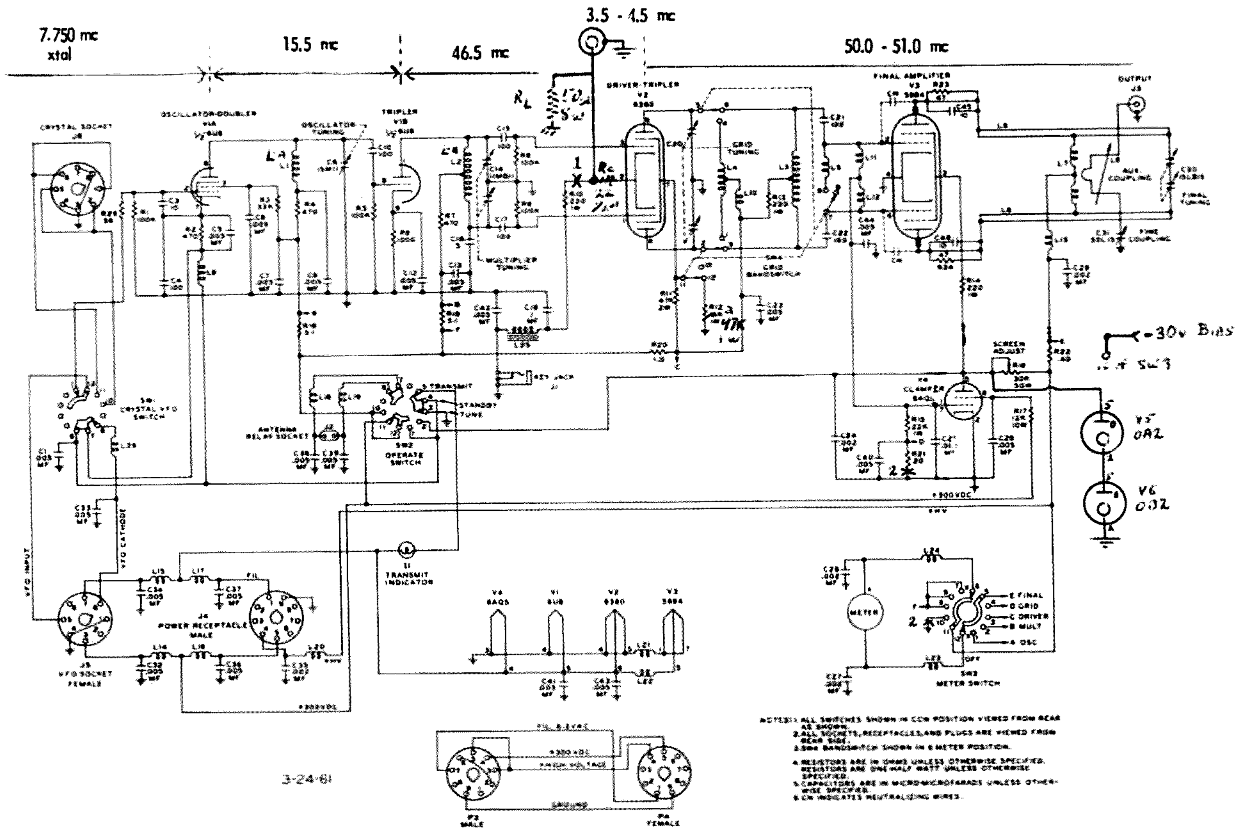
Changing the Johnson Viking 6N2 Transmitter into a heterodyne unit for 6 meters is a very simple modification which can be made for a cost of about ten dollars. The only tools needed are a drill, a ⅝" chassis punch, solder gun, a nibbling tool or file, and a minimum of patience.

The parts necessary for the conversion are as follows:

1. 7750 kc crystal in an FT-243 holder.
2. 1 coax panel mount.
3. V-5, an OA2 voltage regulation tube, socket, and shield.
4. V-6, an OB2 voltage regulator tube, socket, and shield.
5. L-a, 21¼ turns, B & W Miniductor # 3012.
6. L-b, 10 turns, B & W Miniductor # 3010.
7. R-16a, see text.
8. R_L, four 200 ohm, 2 watt carbon resistors in parallel.
9. R-12a, 47K, 1 watt resistor.
10. Rc, 22 ohm, ½ watt resistor.

Now let's proceed with the modification. (After making the modification the unit may be changed to operate as originally with a minimum of time and effort, since the modification involves no major changes).

First, remove all tubes before drilling. Install a coax panel mount in the rear of the chassis between the power plug and the adjacent terminal strip. Disconnect R-10 at pin 2 of V-2 only, and simply bend the resistor away from the tube socket. Connect one end of Rc, a 22 ohm, ½ watt resistor to pin 2 of V-2, the cathode of the 6360. Then connect the center conductor of a length of RG-58/U to the free end of Rc. Connect the other end of the RG-58/U to the coax panel mount. Ground both ends of the braid of the RG-58/U. Next, make R_L by connecting four 200 ohm, 2



watt carbon resistors in parallel; making the connection on each end of the resistors close to the resistor bodies. Cut off excess wire from each end, leaving one lead at each end to make the connections. Now connect and solder one end of R_L to the junction of Rc and the RG-58/U. Solder the other end of R_L to the ground lug next to the V-2 socket.

The next step is to replace L-1 with L-a, so that it will tune 15.5 mc, instead of the original 16-18 mc. Then replace L-2 with L-b, so that it will tune 46.5 mc, instead of the original 48-54 mc. R-7, formerly attached to the midpoint of L-2, is now attached to the midpoint of L-b.

Next, make a hole in the chassis on each side of the Fine Coupling control shaft immediately behind the front panel for each of the two VR tube sockets. Install the sockets so that the VR tubes will be above the chassis. Bring a piece of hook-up wire up through the grommet with the wiring harness for connection to the terminal on R-16a, the screen adjust resistor which has an orange wire already attached. The value of R-16a is discussed under Adjustments. Leave the orange wire attached. Solder the other end of the hook-up wire to pin 5 of V-5, one of the two sockets which was just installed closest to the 6N2 meter. Connect pin 2 of V-5 to pin 5 of V-6, the other socket which was added for the VR tubes. Ground pin 2 of V-6.

Referring to Fig. 2 in the 6N2 Operating Manual, the bottom view of the 6N2, locate R-12 on the left hand side of the figure. Replace R-12 with R-12a, the 47K ohm, 1 watt resistor.

We need a − 30 volts of bias from an external source for the grids of the 5894, V-3. Since the antenna relay and accessory relays may be controlled by the exciter, the antenna relay socket J-2, on the 6N2, may be used for the bias line after disconnecting from it the wires which go to SW-2. Connect a wire from J-2 to the position 10 of SW-3, after having disconnected position 10 of SW-3 from ground. Simply disconnecting position 10 of SW-3 makes both disconnections depicted on the schematic vy "2 X." Since R-21, the shunt resistor, is mounted on the meter switch it is taken care of in the above step. This step applies bias to the grids of the 5894 and also takes care of the metering circuit.

With the exception of R-16a, the modification is now complete.

Adjustments

I am using the Heathkit model HP-20 power supply which provides 600 volts to the plates of the 5894. At this voltage the screens of the 5894 are regulated at 258 volts. R-16a with this supply is a 12,000 ohm, 50 watt resistor. For other values of high voltage, the value of the screen-dropping resistor must be calculated. The VR tubes draw 5 ma and the screen current varies from 0 to 25 ma; a total current through the screen-dropping resistor. In calculating the value of the screen-dropping resistor, do not forget that when the 6N2 is in Tune or Standby positions, the screen-dropping resistor R-16a, is shorted to ground, so do not exceed the power rating of the resistor under this condition.

Install V-3, and the VR tubes, V-5 and 6. Adjust the bias so that V-3 resting plate current is 35 to 40 ma. This will be from − 26 to − 30 volts of vias. Then install the 7750 kc crystal and the 6U8 and the 6360. The clamp tube is left out of the unit in this mode of operation.

In order to adjust the bias from the Heath HP-20, install a 50K, 2 watt wire-wound potentiometer in place of R-6 in the HP-20. The middle terminal of the pot. is connected to pin 1 of the HP-20 power socket.

Operation

If the exciter has more than 12 watts rms output, a pad must be used between the exciter and the 6N2 to limit the input to the 6N2 to 12 watts rms.

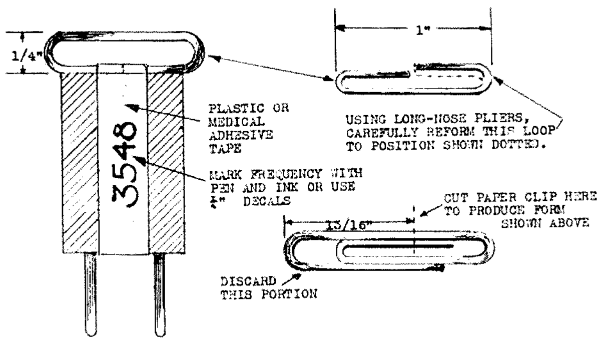
Tune the oscillator and the multiplier of the 6N2 in the usual manner. Tune the exciter on the 80 meter band, 3.5 mc corresponding to 50.0 mc, and 4.0 mc heterodyning to 50.5 mc. Then apply exciter power to the 6N2 and tune the final grid and the final plate of the 6N2 with the exciter in the CW position. Then switch to SSB on the exciter and join the fun on 6 meter SSB.

The reason for using a 7750 kc crystal and 80 meter input is that the crystal multiplies to 46.5 mc, far enough away from 50 mc so that the tuning circuit of the 5894 will reject it. With a 6 mc crystal and 20 meter input, a harmonic occurs at 48 mc which might cause difficulty. It is easier to use the 7750 kc crystal than to use the 6 mc crystal and have to build traps.

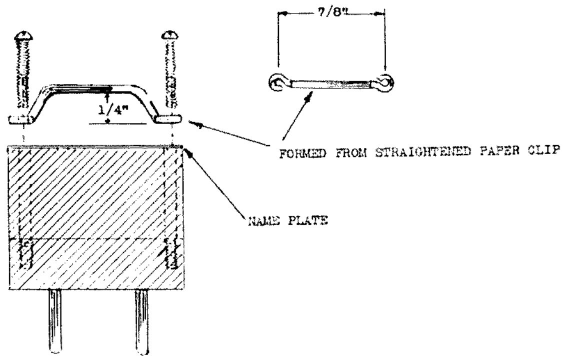
Further information on the 5894 may be obtained by writing to Amperex. . . . K5SGP

Crystal Holder Tips

Tired of breaking finger nails or fishing with tweezers or long-nosed pliers to dig a crystal out of a socket recessed in the panel



PETERSEN TYPE Z-2 CRYSTAL HOLDER (or similar)



BLILEY TYPE AX-2 CRYSTAL HOLDER (or similar)

face in the manner in which some manufacturers persist in equipping their amateur radio transmitters? You can really make it easy

to change crystals in a hurry with nothing more than a paper clip, a few inches of medical adhesive or plastic tape, and a few odd minutes of your time.

The illustrations tell the story. Note that in the Peterson Z-2 holder or those of similar type, the tape will cover the frequency marking on the name plate on the face of the older. Simple; merely letter the frequency on the tape with pen and ink, or, for more professional appearance, use the little decals available at any ham radio supply house.

And, speaking of frequency markings, most crystal holders carry tiny stamped figures which make you squint and peer when searching for the frequency you want. Again, using the small decals, mark the frequency on the edge or face of the holder; you can tell at a glance which crystal is which. . . . W7OE

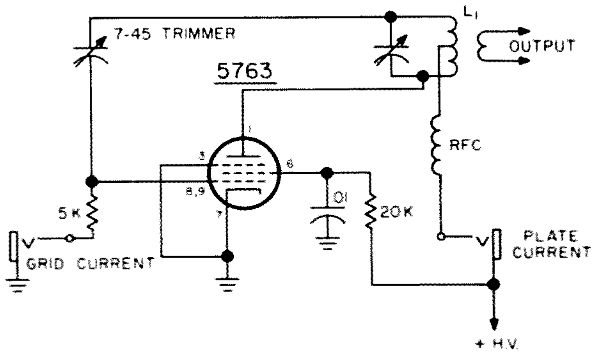
Bill Hoisington K1CLL
Peterborough, N. H.

Unit Power Oscillators

Low cost oscillators from 200 to 650 megacycles. High power (25 to 50 watts) units are described for experimental line or cavity testing, antenna experiments, and transmitter drive work. The technician and the UHF experimenter particularly, should be interested in this helpful information which is the result of many years of work.

Introduction

As one works up into the UHF region, two facts become more and more apparent. One, it is much better to double, and two, it is also much better to start at the final and work back through the drivers and multipliers. Too many times I have blithely followed the carefree words "Then tripling to 432" (or 1296). By the time I tried to triple to 1296 the drive was way way down from what it should be. A great help in this situation is doubling instead of tripling. Don't forget, the



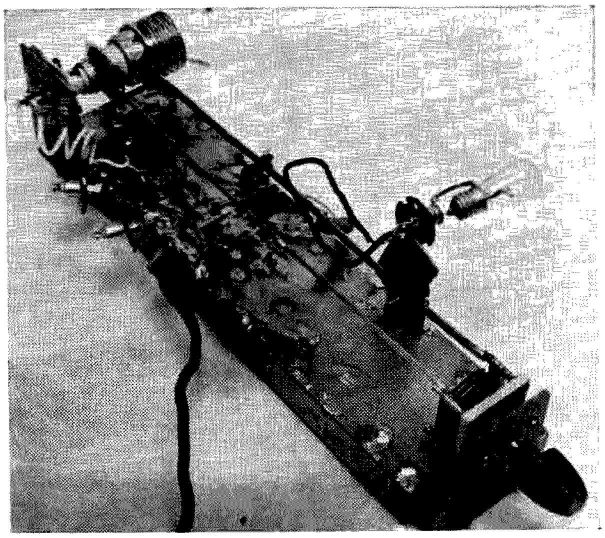
L1	Mc
3 TURNS 5/8" O.D.	110 - 170
4 TURNS 3/4" O.D.	85 - 110

Fig. 1. 85 to 170 mc oscillator

first "big bang" you come to as you frequency multiply up is the *doubling* frequency! Further up you find a little weak spot of energy. *This* may be the tripling spot.

Granted, doubling only throws out *some* of the harmonic relations found on 144, 432, and 1296 megacycles, but from a power and operating standpoint you may find it obligatory. All harmonic relationship is not lost by any means. One 27 mc crystal (CB unit) goes to 54, 108, 216, and then 432 megacycles. The same xtal will go to 81 megacycles (tripling is still not too bad there) 162, 324, 648 megacycles, and then to 1296! Suit yourself. At least the oscillators to be described (Yes, I'll get to them eventually) will help you work it out.

Remember, if you have some four or five



190 to 250 mc oscillator

multiplier stages set up and then have to rework them it may be quite a deal when you find that you have insufficient drive to the final. Especially as such reworking will generally mean bigger tubes or an in between amplifier stage. You will see these amplifiers quite often in commercial rigs, where they had to use one in order to get sufficient drive for the next stage. This is OK when all you have to do is call the purchasing department for another UHF tube!

Working *backward* from the final, you know just where you are as regards drive, one stage at a time.

The oscillator of Fig. 2 covers 190 to 250 megacycles. This can be used to check doubling circuits from 216 to 432 megacycles.

The next, Fig. 3, covers 400 to 500 megacycles. This is useful for decisions on whether to use lines or cavities on your 432 stages.

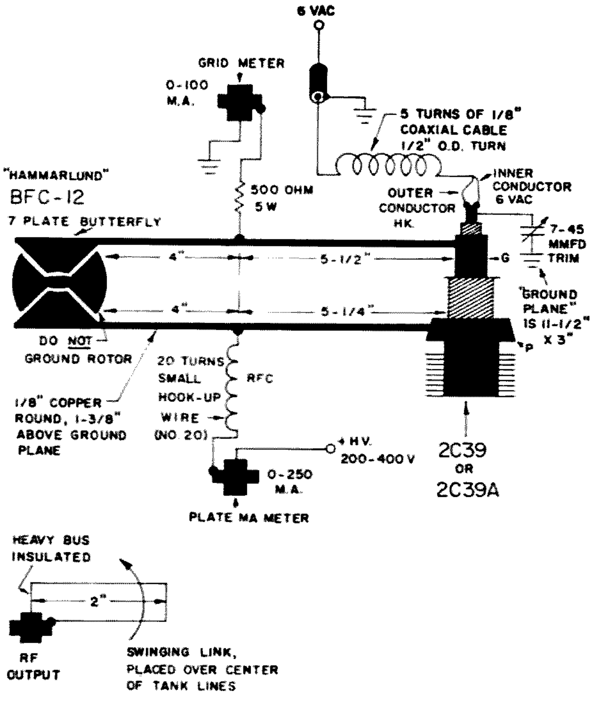


FIG. 2

Fig. 2. Power oscillator 190 to 250 mc.

The highest frequency of this economical series runs 600 to 650 megacycles and is mainly for checking 1296 megacycle doublers. I have even used it to check transistor doublers (don't scream, please!) This may seem fantastic, to drive a little transistor with a 100 watt tube, but you just run low voltage, 50 to 100 or so on the plate and use very loose coupling. Works F.B.!

1200 to 1300 power oscillators will be investigated at a later date. I have almost decided that perhaps a 600 megacycle oscillator driving a 1200 megacycle doubler would be best. Less FM when you modulate it and you are ready for crystal control later if needed.

By using a high-powered oscillator one can ascertain what grid drive will produce what output in the final; maximum grid mils can be set up; etc. Don't forget that if you are using grounded grid, plate output will go on increasing even though the allowable grid mils are being exceeded! Oscillators are shown for some of the most useful frequencies such as 216, 432, and 600 to 650 megacycles. Numerous antenna tests can be more easily made with more sock in the oscillator. Of course, watch those operating rules and regulations! Personally there have been plenty of times on UHF when *any* signal would have been greeted with joy. In fact, this is still usually the case "up there." VHF-UHF helix type coils, line and strap circuits, and cavities can be handily adjusted for size, length, and resonance, with these units.

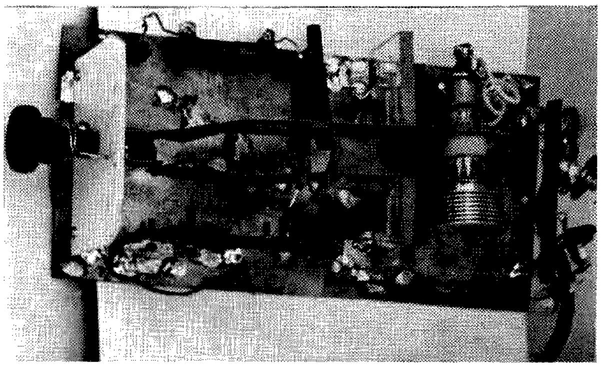
Reasons for Different Types of Oscillators with Increasing Frequency

There seems to be some "Law" operating here. This business of "Laws" is of course buried in Antiquity. (Where is that? Africa? Asia?) From 50 to around 150 megacycles, using a good tube such as the 5763, the old reliable Ultra-Audion circuit does FB. Fig. 1 shows an old version that works well. You can push it a little higher in frequency, at which time putting chokes in the cathode and heater leads will help, but why bother when you can use the circuit of Fig. 2 which "takes off" with as little as 9 volts on the plate!

With all the "2'ers," Gonsets, etc. around, the assumption was made that there is plenty of rf available for 50 and 144 mc tests of all kinds.

200 Megacycles and Up

Things begin to change a little after 150 megacycles. The "plate coil" gets real small and nasty like. Quite a different type of oscillator now enters the scene. See Fig. 2. This oscillator uses a half-wave in each line. One half-wave in the grid line and one half-wave in the plate line. This allows the first quarter wave on each line to be well up inside the tube. It appears to be a "natural" for the region between 100 and 700 megacycles. Look at the size of it on 400 to 500 megacycles! Easy to work with; no need of short leads. Of course this does *not* mean that you can *change* anything shown in the circuit. This oscillator is so good frequency-wise that I had to change the plate and grid lines from one inch brass strap down to "wire." When I say *down* I mean just that. With the brass strap I couldn't get it down below about 280 megacycles. That is, without using longer lines —and look at 'em now. With the wire lines it immediately jumped down to under 200 megacycles. A good live demonstration of strap versus wire.



400 to 500 mc oscillator.

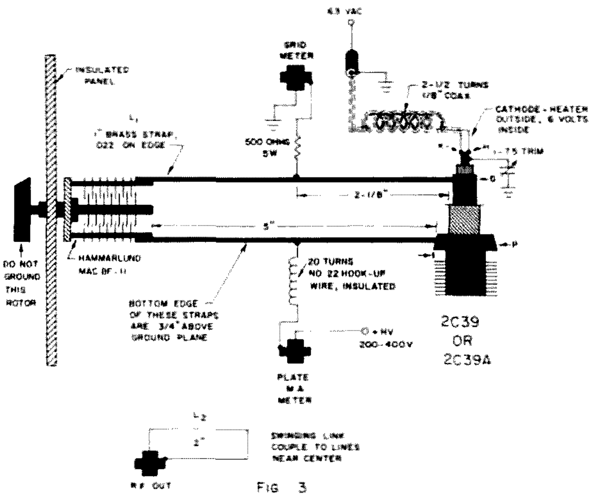


Fig. 1. 400 to 500 mc oscillator.

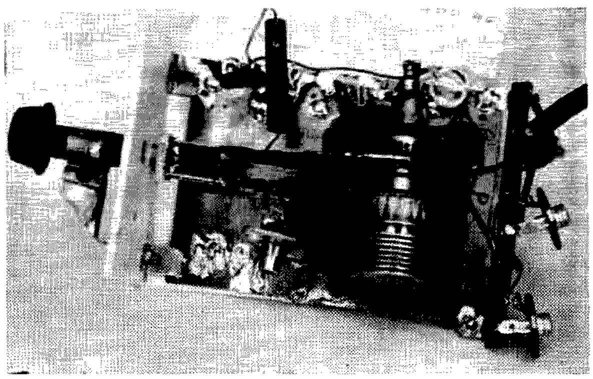
It also is so good efficiency-wise that I checked it out for low plate voltage—always a good test for high-frequency oscillators. It oscillates with *only* 9 *volts* on the plate of the 2C39!

The question of a coax cavity with one quarter wave, or three, or more, does not enter yet into this picture. That comes later, over 1000 megacycles.

Note in Fig. 2 that the plate and grid are at the correct position where the rf voltage is highest, and that they have the proper phase relation to each other. When the plate is at a positive peak (instaneous) the grid is most negative, etc. The tuning capacitor is also at the proper point of high rf voltage, being a half-wave away from the grid and plate end. This is another advantage of this circuit, that the tuning capacitor does not have to be attached at the same end as the plate and grid. The B plus lead with it's choke and the grid resistor are also attached at the best place, which is the *low* voltage point of each line at the highest frequency used. There remains the question of the cathode. Little is usually said about this point in the books, but it gets to be very important up at these frequencies. Chokes are generally installed in the cathode and filament leads and that is about all that is done. More efficiency and power will result, however, from doing something about it—mainly because of the internal tube capacities of a triode when used in an unshielded oscillator circuit.

Using a groundplane at an equal and certain distance from the grid and plate lines (that is, equal from each line) as shown, the cathode connection to the base plate (ground plane) may be broadly tuned with a relatively small inductance made of ⅛ inch coax cable. Use the inside wire for the heater lead to carry the 6 volts to the tube, and a small trimmer capacitor. This cathode peaking is quite broad and may be peaked on the high frequency end of the range used, which is generally most in need of a boost.

Variable output may be obtained with a loop over the *low* voltage (rf voltage, that is) high current region. This can easily be found by touching the lines with a pencil while watching the output or the grid meter. This same method should already have been used to find this zero rf point for attaching the plate choke and the grid resistor. These points are indicated in the figures, but it won't hurt you to check them. (That is, if you don't hit the plate line with your bare pinky). If you have not tried this yet you will be interested. (I mean with the pencil, NOT your finger). The fact that you can get full power output with even a screwdriver touching the plate line is of course an important key to understanding the action of electro-



600 to 700 mc oscillator.

magnetic waves on conductors and resonators. These waves are *not* motions of *electrons*. They couldn't go that fast, even if they tried, which they don't! I have also heard mentioned the quaint idea that "One electron pushes the next, etc." *This* would mean that each electron down the length of wire would have to accelerate faster than the speed of light.

Nobel prize winner Louis De Broglie had the correct words: "The displacement current of Maxwell, which always exists, is absolutely independent of the motion of electricity." This "motion of electricity" was previously defined as the movement of the electrons themselves. I generally use the term "electron wave" myself, but this could be mistaken for the electrons moving too, so I guess the term "electromagnetic wave" would be best. There is of course, a difference when this wave travels on a conductor and when it travels through (more or less) empty space.

Well, anyway, this wave travels back and forth from one end of the line to the other, much like a spring clamped at it's center. The

travel (voltage swing) of each end of the spring is changed to elastic strain (current swing) at the center. The old business of potential energy and kinetic energy in a pendulum. The momentum principle is well recognized by the term "flywheel effect" in an electronic tank circuit. As applied to a half-wave line it means that at the exact electrical center, there is an extremely small variation in voltage from one instant to the next. It theoretically gets to be "infinitely" small, but remember, as the old German professor said about Infinity "Dis ve don't got!" Don't forget, at UHF "ground" is only a place that has the *same* voltage potential all the time. However, at the center of this half-wave line there *is* a *maximum* of *current*, so this is the place for low-impedance magnetic current loops to

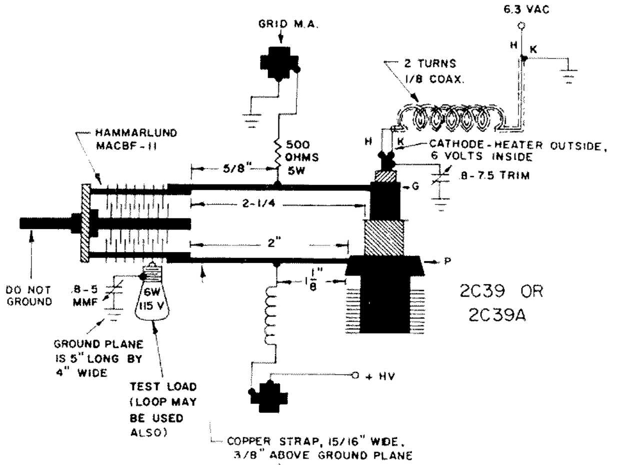


FIG. 4

Fig. 4. Power oscillator 600 to 700 mc.

match to low impedance cables, etc.

Construction Details and Components

As can be seen in the figures, these units can be made up rather quickly providing that you have the following items in your "junk box";

1. 2C39 plate and grid rings and heater-cathode connection. The ones used here are surplus items, from WW2 gear. You can get them brand new from the Instrument Specialties Co., Little Falls, N.J.
2. Butterfly capacitors. These are standard Hammarlund type MACBF or BFC.
3. Copper-clad bakelite. You can use a chassis, but this stuff goes a lot quicker. From Meshna's, or Insulating Fabricators of Watertown, Mass.
4. 2C39 tubes. Just look in the surplus lists if you haven't any on hand.
5. Incidentals. Get copper strap and sheeting from your plumber. I use phono plugs and jacks in the B plus and grid current leads.

I might mention in passing that with certain tuning of the cathode inductance, and only 500 ohms of grid resistor, you can get as much as 100 mils in the grid. I use the low value of grid resistor mainly because you can get good output with low plate voltage that way. As I have mentioned, you can run much more voltage and increase the grid resistor. Suit yourself on that one. Also, all my experimental power supplies have had 4 pin power sockets, so all my test rigs have 4 pin power plugs. B plus, 6 volts ac, and ground. This is just handy. If you need lots of watts you should run a blower on the 2C39's. They are right out in the open so it's easy. If you want to go for *maximum* watts, like near 100, look in the book first and then juggle plate volts, plate mils, grid mils, and grid resistor. A 10 watt wire-wound 2000 ohm job helps there.

That's about all there is to say about construction. The schematics should tell you the rest of the story. Hope this helps you with your UHF work.

. . . K1CLL

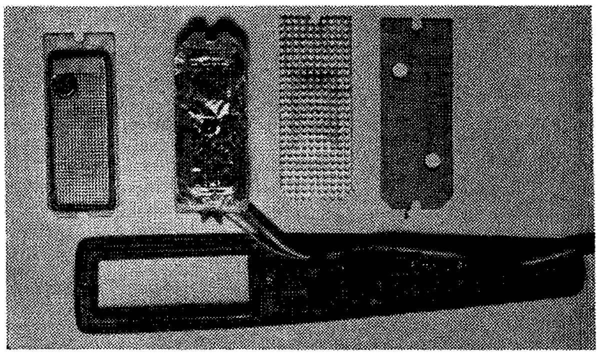
Roy Pafenberg W4WKM
316 Stratford Avenue
Fairfax, Virginia

Repair That Mike

You fire up the rig in plenty of time to keep that schedule and are looking forward to a full evening of rag-chewing. Everything looks O.K. so you press the push-to-talk switch and start calling. Plate power comes on but that's all—no modulation. You plug the phones in the monitor and crank up the audio gain but, aside from a slight increase in hum level, nothing happens. You, my friend, have a problem. You can either return to the family and try to convince the XYL that, even after all of these years, you still prefer to spend a quiet evening with her or you can try to find the trouble. The balance of this article is for the latter breed of ham.

Typical inexpensive replacement cartridges available from many distributors (Lafayette in this case).

The first step is to localize the trouble. Disconnect the microphone connector and switch the transmitter to transmit. Touch a screwdriver to the "hot" contact of the transmitter mike connector. If the transmitter jumps off the table and the monitor blasts your ears, you have localized the trouble. However, at this stage, do not be dismayed. Many microphone defects occur in the cable or connectors. Connect the mike cable back to the transmitter and, if your mike has a connector at the microphone end, unplug this connector. Now perform the touch test again. If the transmitter still jumps off the table, flex the cable, especially near the connectors. If still in doubt as to the condition of the cable, remove the connector shells and examine the cable terminations. If the cable seems in good condition, you have isolated the trouble to the microphone proper. Reconnect the cable to the microphone and move on to the next step which also applies to mikes which have the cable permanently attached.



Microphone disassembled and ready for repair. The rectangular object with leads attached is the cartridge.

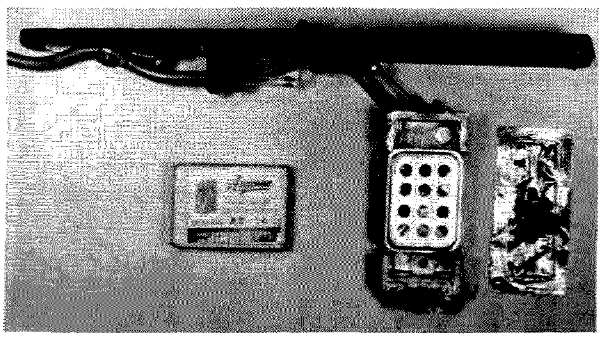
Carefully disassemble the microphone case. In most cases, the method of disassembly is obvious. Do not tamper with the microphone element or cartridge at this stage. You are only gaining access to the cable terminations. Once more perform the touch test and if you obtain the same result, the microphone element is definitely defective. If the hum test has provided doubtful results, unsolder the hot lead from the cartridge and try again. This test will isolate a partially shorted cartridge which the touch test would not otherwise disclose.

Assuming you have isolated the trouble to the microphone element proper, you now have a decision to make. The primary factor in reaching this decision is the replacement cost of the mike. If it is a $2.95 home recorder special, salvage the cord, heave it in the ash can and buy another. It is not worth repairing. However, if the microphone is of good quality, with a good stand push-to-talk switch or other desireable features, you will be well advised to consider repairs. Check your catalogs for a direct replacement cartridge for your particular mike. If you have no luck, check with your distributor; his catalogs may show a replacement cartridge. Assuming you have no luck in finding a direct replacement, you can still repair the mike for a very

nominal sum.

A wide variety of imported crystal microphone cartridges and microphone units usable as replacement cartridges is now available at low cost. The photograph shows the range of units that is available from just one national distributor—Lafayette Radio Electronics of New York. These units range from almost exact replacements for a large number of U.S. manufactured microphones to miniature mike units that may be housed in the case of your defective mike. The photo caption gives the Lafayette catalog number, description, physical size and price for each of the economical units shown.

If one of these units is a direct or almost direct replacement for your microphone, you are in luck. For a very nominal sum and with very little effort, you can restore your mike to new condition. Even if a direct replacement is not available, do not despair. You can still use one of the other cartridges if it will physically fit in the microphone housing. The photographs show the installation of one of these cartridges in an Electro-Voice Type 927 Crystal Microphone. This mike is the property of W3JHN and after the unit failed, he unsuccessfully tried to locate a replacement cartridge. As is common with many of the newer "slim-line" mikes, none of the commonly available replacement cartridges would fit into the available space.



The new cartridge installed in the old cartridge housing and ready for assembly.

Disassembly of the microphone is shown in the photograph. The existing cartridge is a heavy die-cast unit and the mounting screws also secure the grill and the acoustical baffles. Careful measurement showed that the Lafayette PA-40 Subminiature Crystal Microphone could be fitted into the original cartridge. The inside of the cartridge was cleaned out and the die-cast case cut out with a file to accept the Lafayette unit. The attached leads of the Lafayette unit were then soldered to the existing terminals (hot-to-hot and ground-to-ground) inside the old cartridge. The case of the PA-40 mike was then cemented in place with one of the commonly available, "two-part" epoxy cements. After the cement dried, the unit was given a quick talk test and then reassembled with the original baffles and grill.

Now came the problem of matching the acoustics of the microphone to the new cartridge. This was strictly a trial and error proposition and I am convinced that, even for the manufacturers, this is more of an art than a science. The assembled microphone was carefully tested and the results were less than satisfactory. The lower frequencies were "muddy" and the higher frequency components had an undesireable echo effect. The first step was to stuff the remaining space inside the original cartridge case with cotton. This eliminated the high-frequency echo effect but the low frequency response was still unsatisfactory. As shown in the photograph, a cardboard baffle plate with two small holes is used in the original assembly. Additional holes were punched in this baffle and the mike reassembled but without a fiber-glass cloth acoustical filter (not shown) which was also used in the original assembly. Performance was greatly improved with the sole remaining problem of excessive sibilance and breath noise. Reinstallation of the fiber-glass cloth cured this problem. The results of this repair were quite satisfactory and the defective microphone returned to service at a fraction of its original cost.

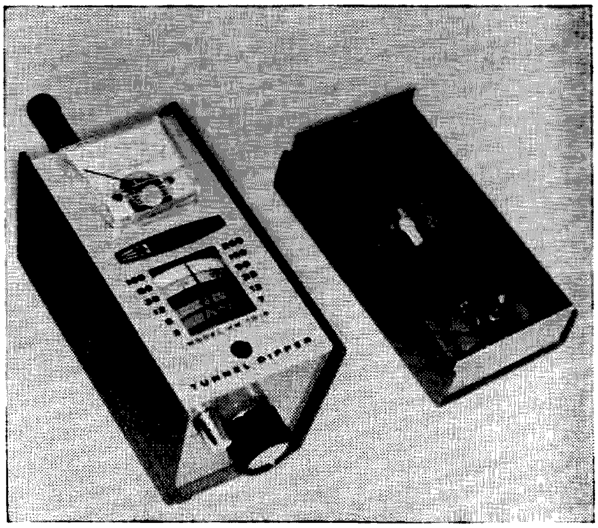
While the specific procedures described above may not be directly applicable to other microphones, the general techniques are. Select a replacement cartridge that will fit in the available space. Follow as closely as possible the original mounting method. That is, if the original unit is shock mounted, then shock mount the replacement. If the original cartridge has a high mass and is rigidly clamped in place, then attempt to duplicate the mounting method. In the case described, the weight of the original die-cast cartridge is retained and the replacement fitted in the available space. As mentioned, the acoustics of the microphone will probably be altered. Achieve the desired response by the judicious use of padding and/or baffles, vented or solid. A little trial and error effort will show you what is required to achieve satisfactory performance.

Next time you are faced with a defective microphone, consider repairs. A very modest investment, a little work and small amount of luck will restore your mike to good-as-new condition.

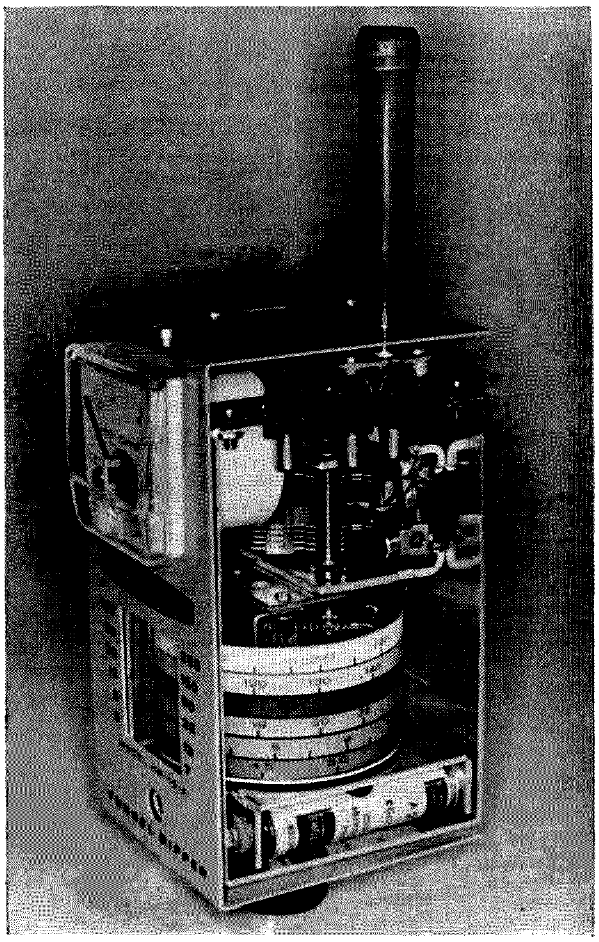
. . . W4WKM

Donald Smith W3UZN
Kent Mitchell W3WTO

The Heath Tunnel Dipper



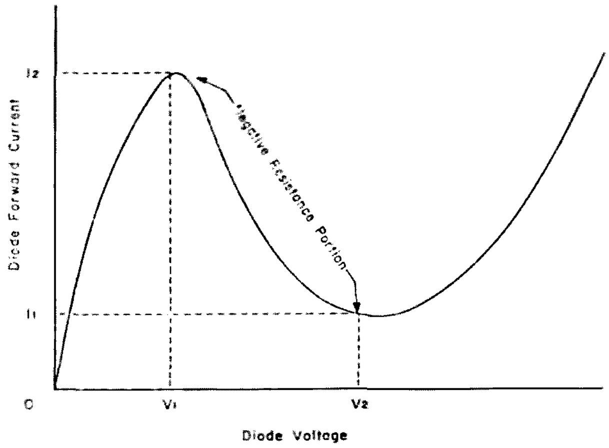
Relatively little time passed between the announcement of Dr. Leo Esaki's research with his specially doped germanium diode junction with its unique "negative resistance" characteristics and Heath's announcement of their replacement for the familiar grid-dip meter. Anyone who has seen the Tunnel Dipper will be quick to agree that Heath has added another winner to their long and growing list.



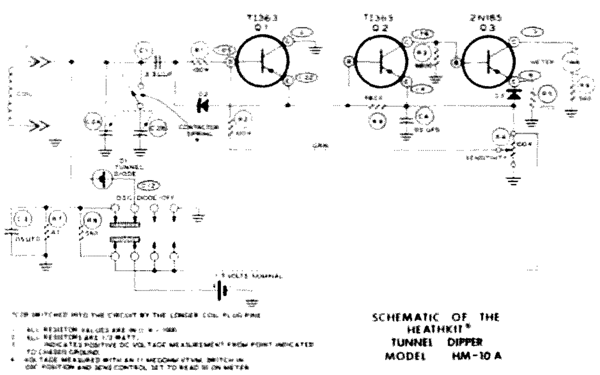
Retaining all of the features of the now familiar conventional grid-dip meter, this instrument provides an additional advantage . . . freedom from external power requirements. This opens up new areas of utilization which previously have not been convenient, such as tuning antennas on the house roof or at the top of a tower, and adjusting mobile rigs and antennas.

Covering a frequency range of 3 to 260 mc, the Tunnel Dipper contains a completely solid-state circuit requiring only a 1.5 volt battery and draws only 5 mils! The complete schematic is shown in Fig. 1. The tunnel diode functions within the oscillator circuit, the frequency of which is determined by the inductance of the plug-in coil in parallel with variable capacitor C2. The oscillating voltage developed across this tank circuit is rectified by D2, an ordinary diode, applied to the base of transistor Q1 operating as an emitter follower, and amplified by the dc amplifier consisting of transistors Q2 and Q3. The meter is in series with the collector of Q3 and measures the current, which of course is proportional to the amount of rf voltage being developed at the other end of the circuit, the oscillator tank. When the tank circuit coil is placed adjacent to a tuned circuit of the same resonant frequency, inductive coupling results in absorption of energy from the tunnel diode oscillator circuit, in turn producing the characteristic dip of the meter, indicating resonance.

For those who are puzzled about how a diode is able to function as an oscillator, a few brief words of explanation might be justified at this point. Ohm's law tells us that when voltage across a resistance is increased, the current through the resistance also increases. The same law also applies to an ordinary diode which is, after all, a resistance too. However,



a tunnel diode, due to its special doping during manufacturing, displays a characteristic resistance curve as shown in Fig. 2. Notice that between voltage levels of 0 and V_1 the diode current increases as would normally be expected. However, as the voltage increases be- V_1 and V_2 the diode current defies Ohm's law and decreases! The diode is actually displaying "negative resistance!" Increasing the applied diode voltage beyond V_2 produces a normal current response. Therefore, it is the region of "negative resistance" that interests us and in which the oscillation is produced in the tank circuit in the following manner: as the voltage supplied by the 1.5 volt battery reaches its maximum across the tank circuit, consisting of the plug-in coil and C2, the voltage across the tunnel diode is at a minimum, operating near point V_1 of the curve shown in Fig. 2. This results in a large current flow to the tank circuit from the battery. Conversely, when the voltage across the tunnel



Specifications

Frequency Range	3 to 260 mc. (using six plug-in coils)
Circuitry	Solid State: 1 tunnel diode, 1 silicon diode, 1 crystal diode, 3 transistors
Controls	Tuning, Switch (Off-Diode-Oscillate)
Power Supply	AA penlite cell (1.5 volt) not furnished
Dimensions	5⅞" long, 2 13/16" wide, 4 3/16" high
Weight	1½ pounds
Price	$34.95

diode becomes maximum, near point V_2 of the curve, the current through the tank circuit becomes minimum. By this process, each cycle of current in the tank circuit is replenished by current from the battery. The tunnel diode itself does not actually oscillate, but simply acts to maintain the oscillations in the tank circuit.

Construction of the Tunnel Dipper is relatively easy, thanks to a small etched circuit board and a well written assembly manual. Approximately 4 to 5 hours are all that is required to perform the 73 (how about that!) construction steps and operation checks.

Operation of the unit is simple, requires no warm-up, and employs vernier gear-driven tuning. Other features of the instrument well worth mentioning are the color coded plug-in coils and corresponding colored dial scales, built in storage space for the coils, and sturdy RCA type phono plugs and sockets for the coils . . . an improvement over earlier model grid-dip meters whose coil-socket arrangements sometimes became intermittent after extensive use.

Priced at $34.95, Heath's Tunnel Dipper is a worthwhile addition to any ham shack . . . and will cause you to wonder how you ever got along without one.

. . . W3UZN

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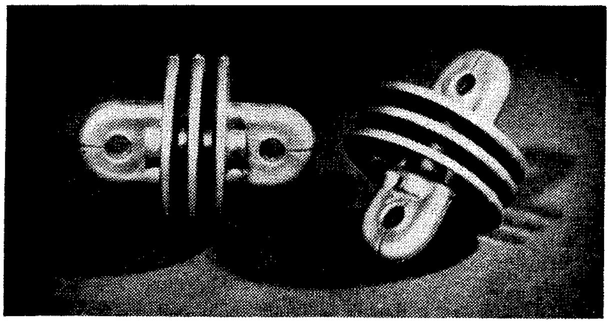
IN MEMORIAM

The Maskwoosicut Mules Radio Club in Sharon, Massachusetts has come up with an idea that seems well worth while passing along. When their founder John B. Morgan WB2LZG/ ex K1RHP died recently they decided to establish as much of an amateur radio and electronic theory collection of books in the local library in his name as they could afford. They wanted to do something useful.

CLOTHING NEEDED

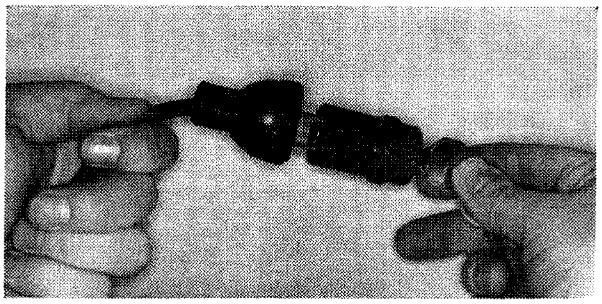
The Moonlighters of Eastern Tennessee Amateur Radio Club is helping out with a clothing drive and hopes that all amateurs will take a close look through their attics and closets for clothes which still can be of service. Send them to Save The Children Federation Processing Center, Knoxville, Tennessee by prepaid parcel post and mark the contributions with your call letters, name and address. The clothes will be cleaned and mended, where needed, and distributed in Virginia, Tennessee and Kentucky or put aside for emergency use in time of disaster in the U. S. or in free countries overseas.

New Products



HiQ Plastic Insulators

Model HQ-2 insulators offer all the electrical and chemical advantages of molded acrylic plastic. They combine high tensile strength and extreme resistance to weather and temperature changes, while providing excellent insulating properties. The insulators have reinforced rib structure surrounding the tie points to assure extra strain and vibration resistance for long-wire antennas over one kw input. The insulators measure 2" x 1½". Details about the insulators, list priced at 99c a pair, are available from Budwig Manufacturing Co., P. O. Box 97, Ramona, Calif.



Hurd Power Lock

According to FCC regulations, an Amateur radio station may be operated only by a person holding a valid amateur operator license. To prevent unauthorized use of your equipment, and also prevent accidents with power tools involving children, invest $1.49 in this locking device manufactured by the Hurd lock company.

Designed to fit either 2 or 3 pronged AC plugs, the lock is simply mated with the plug, and with a twist of the key two internal pins extend through the holes present in the prongs of every plug. Very clever.

Available in any hardware-electrical type store.

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(Act of October 23, 1962; Section 4369, Title 39, United States Code)

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POD Form 3526 Aug. 1963

Letters

Dear Wayne:

Surprise! This is not a hate letter, but one I hope will encourage you to continue to fight with your editorials and the right of your opinion and others. The past year or more I have been following your editorials plus the big one, RM-499, and am positive that you have many thousands of hams behind you. I'm sure there are many thousands more that haven't taken time out to write to you. Reading Octobers' editorial I felt that you might be a little distressed. I felt that maybe you might throw in the towel. You are appreciated on your comments and ideas. Please. Whether you are right or wrong on any issue you are the champion of hundreds of thousands of hams. How would they be able to voice their opinions or fight for their rights if you did not take the position you did.

You are our source of information. Now *we* know what the other side is doing. You are in a position to have mail crossing your desk from all parts of the country (you still have that five dollar desk?). You, like Drew Pearson, must have many spies across this country to get this info. How are we to know if you don't tell us. Don't let it be hidden in other magazines where you need a microscope to read the print.

I agree as much as any one that ARRL has done a great deal for the ham. But let us not go back to the great deal for the Ham. But let us not go back to the good ole days but forward and don't sit back on our laurels. I am a sales rep. In our business it's not what we did yesterday but what we did today and what we plan to do in the future. I can't see why any organization can't take criticism unless some of the things said are true.

I believe, as in business, you need to have competition to keep everybody honest. I feel sure that there is room for ARRL and IoAR. This is keeping the other guy honest and it's the way things should be. You have been accused of dividing the hams but this is not so. I think you have strengthened us. You have taken issue with that dirty ole RM-499 and other issues. Whether we agree with you or not you have opened up our minds not to be hogwashed by what our leaders have to say. Now we can learn what both sides of the story are. Now we can read between the lines. Now we can smoke Viceroys and be thinking men. Now we don't fall hook line and sinker for anything that is said until we have the facts. Is it wrong to ask about and discuss issues or do we have to take it like other countries that can't voice their opinions? We want to stand on our own two feet and not let somebody else do the thinking for us. This is a democracy.

There has been a great deal of name calling on both sides. This sort of reminds us of our present presidential race. This is not weakening or dividing the country. I also think that what you are doing is not weakening ham radio, but putting a little strength into it. In event of a emergency I am sure the two political parties would act together and I feel the same way in our hobby of amateur radio. We have room for another organization such as IoAR. As mentioned before, you have had the GUTS to stand up under pressure with your convictions and ideas. Let your conscience be your guide and I am sure you will come out on top. Keep up the good work.

Ray Gianchetti WA2CUB/W3QLZ

Dear Wayne,

You are a crusader and I would sure like to get someone like you to join me in a war to the bitter death, hi! What is really bugging me is all the clicks, clacks, buzzes and horrible noise in general on the amateur bands. Serious offenders are television horizontal oscillators and thermostatically controlled devices such as electric heating pads, blankets and butter warmers in refrigerators. The best solution to this problem is Canada's—make the radiation illegal! So we need some lobbying. General Electric has a heating pad Model P36 retailing for $6.95 that says on the package "radio and television interference free." Every amateur should know about this either for the use by his own family or to suggest to a noisy neighbor.

Ideally, we need a law that states something like: "any device generating any electromagnetic radiation at any frequency such that the intensity at 50 feet exceeds a level of 2 (?) microvolts per meter must be licensed by the Federal Communications Commission." Penalty for non compliance should be at least $500 per day or 30 days in jail for each day of non compliance. It would be amazing how quickly power line insulators, neon signs, diathermy, theromostats etc., etc., would be replaced. If there are applicable existing laws, they either are inadequate or not enforced.

Curtis W. Reedy, W6YTA

How about the chair?

Dear Wayne,

As it must to all hams, silence came to the key and voice of our fellow amateur, William E. ("Wimpy") Turner, K4ECJ, on September 29, 1964.

As a ham "Wimpy" asked for nothing but he gave much. His friendship and his vast technical knowledge were always yours for the taking. His wit and good humor were always quick and razor sharp, yet never failed to be filled with the milk of human kindness. Although he had been blessed with little formal education, the depth of his knowledge and erudition exceeded that of many a college professor. He could, and did, discourse with great intelligence and understanding on any subject, yet he always kept his mind open to consider an opposing point-of-view. In short, "Wimpy," more than most of us, was truly a ham's ham.

We who knew him well will never be able to fill the void left by his passing and the angels should forever rejoice for his arrival. His big signal and kindly voice will never be forgotten.

"Grant" W8NZQ

Sir,

I am in need of data for my research at the University of Wisconsin, Department of Meteorology, on any occurrences of six meter band openings during the period from August 25 to September 25, 1964. Information desired is, stations heard or worked, time and date, QTH if known, and the time at which the band opened or closed, if known. In my study periods periods during which the band is closed is of importance also.

Thomas D. Damon W9HAQ
1125 Northland Drive
Madison, Wisconsin 53704

Dear VHF Editor,

Since I am VHF/Technical editor of the "FEAR(M) NEWS" I thought I should fill you in on VHF operation in Japan.

We have only two VHF bands here, 50-54 Mc. and 144-146 Mc. Power input is limited to 50 Watts. The normal microwave bands (starting at 1231 Mc.) are available also with 50 watts maximum input.

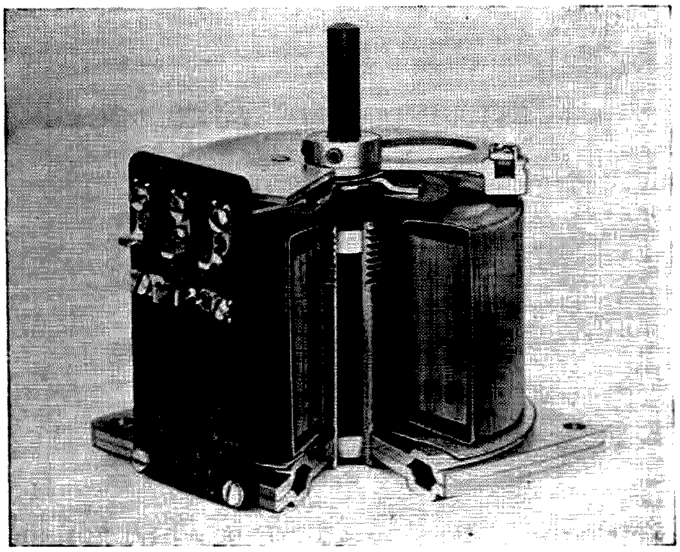
Almost all of the operation here is on 50 Mc. AM. KA2's CM, DF, JW, KS, LD, MB, NA, PA, RD, RJ, SF, YP, and KA9's AB and FH are on six meters. KA2KS, KA2RJ, and KA9FH are on two meters also. KA2RJ is on SSB with transverters.

Six meter DX from Japan includes Korea and Okinawa via sporadic E in the summer and Australia via Transequatorial skip in the Fall and Spring.

I hope this info will be of interest to those who are contemplating duty in Japan soon.

Ron, KA2RJ (W9VCH)

Charles Miller W1ISI
85 Hammond St.
Acton, Mass.



More Power to You:

The Autotransformer

The variable-ratio autotransformer, more commonly known by trade names such as Variac(R), Powerstat(R), etc., has been with us for many years. Recently the surplus and "second-hand-new" outlets have begun to offer them at very attractive prices. Most of us are aware of its usefulness when used by itself to provide a variable ac voltage from the 60 cycle line. There are methods of greatly extending its usefulness which are not so commonly known, however, and some of these will be presented here.

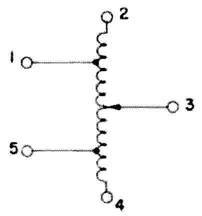


FIG. 1

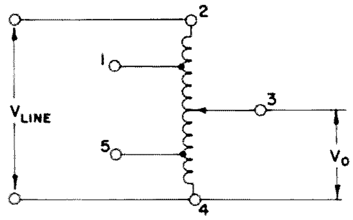


FIG. 2

Fig. 1. Basic variable-ratio autotransformer circuit.
Fig. 2. Illustrating the line-voltage connection.

The Variac

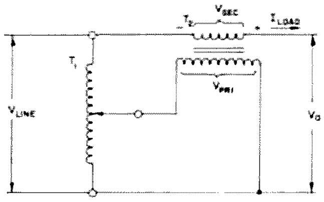
Perhaps we first should know what the variable-ratio autotransformer is and how it works. A note of caution is in order here. In addition to standard catalog models, each manufacturer builds an almost unbelievable number of "specials." Both types often appear later as surplus at very attractive prices. It pays to be sure of what you are ordering, and such information is free for the asking. Although the General Radio Variac(R) will be used as an example, the principles involved will apply to variable-ratio autotransformers of all manufacture.

A cut-away view of a typical Variac appears in the photo. The corresponding schematic diagram appears in Fig. 1. Basically, it consists of a doughnut-shaped iron core on which is a single-layer toroidal winding. The winding is tapped near each end, with the end and tap connections brought out to a terminal plate. The insulation is ground off the winding at one end of the doughnut to provide a track on which a carbon brush makes contact. Electrically, the brush is connected to a terminal on the terminal board. Physically, it is attached to the shaft. The shaft may be rotated through about 320°, sufficient to allow the brush to travel from one end of the winding to the other.

In an autotransformer, the single winding acts as both a primary and the secondary. If the ends of the winding are connected across the power line as shown in Fig. 2, the line voltage will be equally divided by the number of turns. This results in a fraction of a volt across each turn. All the turns are utilized as the primary. The turns across which the output is taken correspond to the secondary of a conventional transformer. The number of these "secondary" turns, each with its volts-per-turn contribution to V_o, is selected by the brush. Thus, as the control knob is rotated, the brush contact traverses the winding, tapping off a portion of the total voltage across the winding, and the output voltage,

V_o, is continuously adjustable from 0 to as large V_{line}. If V_o is taken between terminals 2 and 3, operation is the same except that the direction of knob rotation for increasing or decreasing V_o is reversed. In either case, Fig. 2 illustrates the so-called "line-voltage" connection.

The second basic connection is illustrated in Fig. 3, the "over-voltage" connection. By connecting one side of the input line to the end of the winding and the other side of the input line to the tap near the far end of the winding, V_o is continuously adjustable between 0 and the input line voltage as the brush moves from Tap 4 to Tap 1. As the brush moves from Tap 1 toward the end of the winding labeled 2, additional turns and, thus, additional volts, are picked off. Variacs presently are tapped to provide a maximum output voltage 17% greater than the input voltage with this connection.



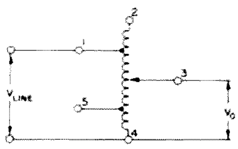


Fig. 4 Fig. 3

Fig. 4. The buck or boost scheme. Transformer T2 effectively multiplies the Variac current capacity and dial resolution.

Fig. 3. Illustrating the over-voltage connection.

In the majority of cases it is not too difficult to determine the necessary ratings. If the Variac is to be used as described, only the line voltage and load current need be considered. The permissible load current is not the same for both connections, being slightly higher for the line-voltage connection. In either case, many times the rated current may be drawn momentarily (such as in motor starting), but brush life will be considerably reduced if the Variac is overloaded for any length of time. Manufacturers usually publish permissible overload data in the form of time-current curves.

The Variac finds innumerable applications in the two connections previously described. Another very useful circuit is shown in Fig. 4. Here the primary of transformer T2 is supplied with the continuously adjustable output voltage of T1. The secondary voltage of T2 is related to its primary voltage by the turns ratio.

$$V_{sec} = \frac{N_{sec}}{N_{pri}} V_{pri} \qquad (1)$$

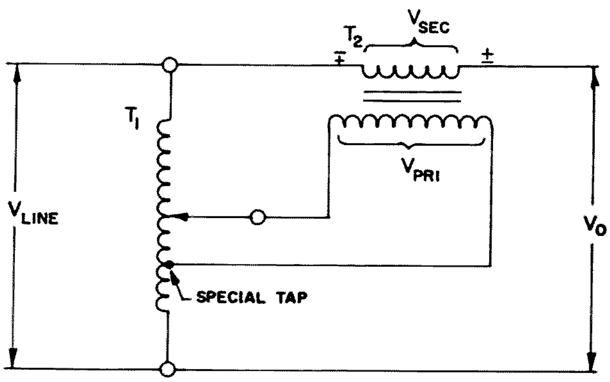


FIG. 5

Method of obtaining both buck and boost operation without switching.

The secondary voltage of T2 is then connected in series between the line and the load. The polarity signs in Fig. 3 are used to indicate that the secondary voltage adds to the input line voltage to give the output, or load voltage.

$$V_o = V_{line} + V_s \qquad (2)$$

Since from simple transformer theory the primary and secondary currents (neglecting losses) of T2 are related by

$$I_{pri} = \frac{N_{sec}}{N_{pri}} I_{sec} \qquad (3)$$

we achieve some rather interesting results. First, if we assume that T2 is a step-down transformer of say 10-to-1 ratio and for T1 connected in the line-voltage connection, V_o may be caused to vary from V_{line} to 1.1 V_{line} as the output of T1 varies from 0 to V_{line}. Thus, we are now able to push V_{line} up by as much as 10%. So what, you say. We could boost the line voltage by as much as 17% by simply using the over-voltage connection on T1 without using T2 at all. True, but the real hooker shows up in equation 3. Plugging in the numbers and turning the crank, we find that the Variac must now supply only 1/10 the load current. Thus, by using the additional transformer, we effectively multiply the current rating of the Variac (and thus the permissible load power) by the inverse of the turns ratio of T2! If we want V_o to be lower than V_{line}, it is only necessary to reverse either the primary or the secondary connections of T2. Simulating line-voltage fluctuations and line-voltage correction are only two of the many applications for this technique. The increased resolution of the Variac dial greatly simplifies the accurate setting of V_o. For a typical application where the line voltage is approximately 120 volts,

T1 would also be a 120 volt model. Commercial line-voltage regulators employing this technique typically have a "buck" and "boost" range of 10%. If T1 is a 2 amp Variac and T2 a 120 volt to 12 volt transformer with a 20 amp secondary, this circuit would be capable of as much as 10% "buck" or "boost" of the line voltage applied to a 2 kw load. It would therefore be quite adequate as a primary regulator in front of a full gallon.

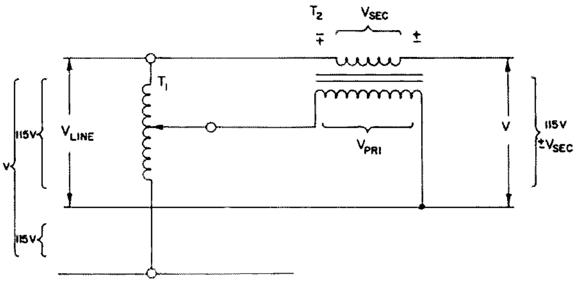


FIG. 6

Buck and boost scheme wherein no tap is required on T1 and T2 may have a 120v primary.

The trouble with most power lines is that the voltage is seldom where it should be, and it is not even there for very long. At best we may consider it usually within a certain voltage range. This may mean that some days you want to "boost" the voltage and other days you want to "buck" it, in which case, reversing the phase of the secondary voltage of T2 (in Fig. 4) could get pretty tiresome. There is a very simple way out as illustrated in Fig. 5. Here we insert a special tap in the electrical center of the Variac winding. Now the voltage applied to the primary of T2 is 0 when the Variac knob is in the center of its travel. Rotating the knob in either direction from this point will increase the voltage applied to the primary. However, rotating the knob in one direction will cause a secondary "buck" voltage, while rotating it the other way will cause a secondary boost voltage. Thus, we get our buck or boost voltage without switching, merely by adding a tap to the center of the Variac winding. Of course, there is a catch to it, and we still don't get something for nothing. Notice that now the maximum voltage we can apply to the primary of T2 is only half the line voltage. If we want to utilize the maximum power capability of T2, we require a transformer with a 60 volt primary winding (when V_{line} is 120 volts). Granted, these are a little hard to come by. Such animals are in existence, and you might be lucky enough to come across one. Otherwise, there are two possibilities if you think the work is worth it. One is to start from scratch and build your own from data such as that given in the Amateur Handbook; the other possibility is to unwind a transformer, such as a large TV power transformer, carefully noting the number of turns on each winding. The primary and secondaries may then be rewound to get exactly the voltages and ratios you want. Again, you should consult the Handbook if you are not sure of what you are doing. One little trick here is to effectively break the original primary in half and then connect the two halves in parallel. It is very important that the number of turns on each half be identical, so you still have to unwind the primary and count the turns. The winding is then broken when rewinding the primary. Tapping the Variac is a very simple operation. Though not essential, the exact center turn of the winding may be located if you're a purist. The center of the winding will be halfway around the doughnut from the terminal board. The turn selected should be lifted carefully away from the outer edge of the doughnut and a piece of insulating material slipped between it and the adjacent turns. The wire should be cleaned and tinned. A lead may then be soldered to it and then brought out at the terminal board.

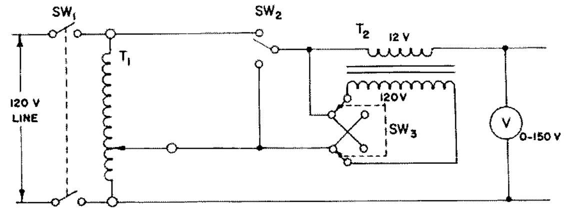


FIG. 7

A versatile power distribution system.

Of course it would be very nice to have both the buck and boost capability with neither a specially tapped Variac nor a special transformer for T2. This sounds like something for nothing again, but it is possible as shown in Fig. 6. Here we utilize the fact that the line coming into most homes is a split 230 volt circuit with a common center. If T1 is now a 230 volt Variac, we may use the center tap on the input line where we formerly required a center tap on T1. Additionally, since the maximum voltage which may be applied to the primary of T2 is again 115 volts, we are back to the garden-variety transformer for the "buck-boost" voltage. Wired as shown, we do get both "buck" and "boost" operation without switching transformer leads. The only problem now is to watch out for the ratings of T1 and the availability of the split 230 volt line. In using such a system, remember there are such things as building codes. As to

the rating of T1 and T2, there should be no problem if you just revert back to our simple equations (1 through 3).

A Versatile Distribution System

One fairly useful combination of techniques previously described is illustrated in Fig. 7. In this circuit, T1 is a standard 120 volt Variac and T2 is a 12 volt filament transformer. With SW2 in the position shown, V_o is adjustable from 0 to V_{line}. With SW2 in the upper position, V_o is adjustable from V_{line} to 10% above or below V_{line}, depending on the setting of SW3. This system is quite useful for bench work, and if the loads to be encountered are relatively small, either the "line voltage" or the "over-voltage" connection may be used for T1. Another particularly useful application for this system is for primary power control for a single sideband transmitter. The lower position of S2 permits the dc to be brought up slowly to charge the normally high value of filter capacitance in the power supply. The upper position of S2 then allows the line voltage to be maintained at the desired fixed level. In this application it might be desirable to be able to switch the voltmeter between the input and output line to determine which position of SW3 will be required. Switch SW3 should be set with SW2 in the lower position and T1 set for zero output. This prevents T2 operating as a current transformer and burning up the contacts of SW3. In determining the ratings of T1 and T2, the following should be remembered. With SW2 in the lower position, T1 supplies only the current drawn by the power supply in charging the filter capacitors and to make up for transformer losses. It is the combination of T1 and T2 together as described for Fig. 4 which supplies the full transmitter operating load. Also, remember that the contacts of S1 and S2 must now be capable of carrying the full output-load current.

. . . W1ISI

Jim Kyle K5JKX
1236 N. E. 44th St.
Oklahoma City, Okla.

Bandpass Coupler Design

"Some commercial and amateur transmitters and receivers too have employed 'broadband' tuned circuits, but few articles for home construction incorporate such conveniences. Can you help me find out how to design these?"

That was the gist of a letter from W5TIR, which sparked this article. He commented that he had been totally unable to obtain any data at all—and when we went looking through our reference library, sure enough there was virtually nothing on the subject.

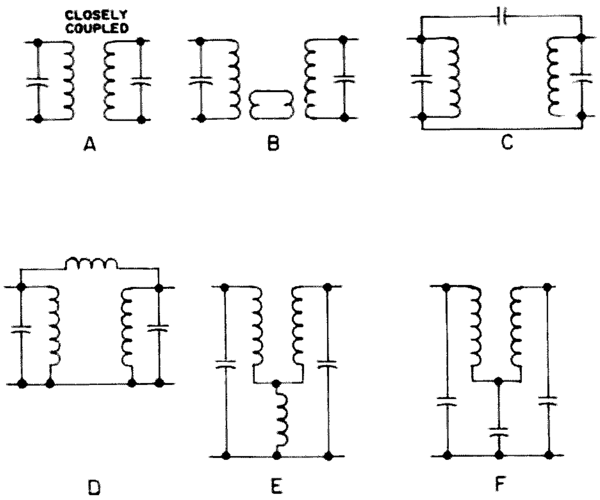


FIG. I
Various bandpass couplers

With the thought that probably many more of us would enjoy the convenience of broadband operation, in which nothing need be retuned except the vfo when changing frequency, if only the data were available, we have cooked up from all the data which *is* available a design technique which is particularly adapted to ham use. It's somewhat involved, but nothing more than ordinary arithmetic need be used to work it out. The result is still subject to a bit of "cut and try", but brings you out closer to target than if no design at all were done in advance. And the result is almost effortless operation, with a bandpass-coupled transmitter.

Before we get into the details of the procedure, let's take a quick look at the various types of bandpass couplers available. All of them are simply overcoupled double-tuned circuits; the differences are in the ways in which the tuned circuits are coupled together.

Fig. 1 shows the six recognized types of bandpass couplers. That at A is both the most widely used and the least simple to work with; it consists of a pair of tuned circuits with only inductive coupling between them. At B is approximately the same circuit except that the inductive coupling has been replaced by a pair of links. Though popular, neither of these couplers lends itself well to predetermined design techniques.

The couplers from C through F may not be so familiar to most of us. They rely upon having a reactive element which is common to *both* tuned circuits, and the coupling factor is determined solely by the ratio of this coupling element to its similar reactances in the rest of the circuitry. For instance, in the top-coupled capacative circuit of C the coupling factor is equal to the ratio of the coupling capacitor to the geometric average of the two tank capacitors. For small coupling, the coupling capacitor must be very small. At D is the top-coupled inductive circuit, while E shows the bottom-coupled inductive circuit.

The one we will be working with, however, is the bottom-coupled capacitive coupler shown at F. This one uses reasonably large-value coupling capacitors (the larger the capacitor, the less the coupling) and is most adaptable to general ham applications. In this circuit, the coupling factor is the ratio of the geometric average of the tank capacitors to the coupling capacitor. If both tank capacitors are equal in value, say C_a, then coupling factor k equals C_a/C_c.

For any of the mutual-reactance couplers to work properly, inductive coupling between the coils involved must be eliminated. This can usually be achieved by mounting the coils at right angles to each other; adding an aluminum shield between them helps too.

The coupling in this circuit works this way: At resonance, circulating current flows back and forth through the input tank circuit made

up of L, C_a, and C_c in series. The voltage developed across C_c depends both upon the current and upon the reactance of C_c; the larger the reactance, the less voltage. However, C_c is also a part of the output tank, and any voltage developed across it is also applied across L and C_a (on the output side) in series with each other. This in turn causes current flow, which results in circulating current in the output tank.

TOP RIPPLE	TANK Q	COUPLING FACTOR k	TUNEUP FREQ.	—20 db
0.8 db	$\frac{5(F_h+F_l)}{4(F_h-F_l)}$	1.41/Q	$F_{av}-\frac{F_{av}}{2Q}$	$\frac{11 \times F_{av}}{4Q}$
3 db	$\frac{8(F_h+F_l)}{5(F_h-F_l)}$	2.45/Q	$F_{av}-\frac{F_{av}}{Q}$	$\frac{22 \times F_{av}}{4Q}$
6 db	$\frac{11(F_h+F_l)}{4(F_h-F_l)}$	4/Q	$F_{av}-\frac{19F_{av}}{10Q}$	$\frac{27 \times F_{av}}{4Q}$

F_h - Upper Desired Frequency Limit
F_l - Lower Desired Frequency Limit
$F_{av} = \frac{(F_h+F_l)}{2}$

TABLE 1. Tank Q, coupling factor, tuneup frequency, and −20 db bandwidth for bandpass circuits.

The bandpass action comes from overcoupling of the two tanks. If each tank has the same Q, and coupling factor *k* is less than 1/Q, then the two are "undercoupled" and power transfer will be less than maximum. When Q is held constant and *k* increases (by reducing the value of C_c and returning the tank to resonance) until the product of *k* and Q equals 1, we reach "critical coupling" where power transfer is maximum. As *k* is increased still more, we find a dip in power transfer at the resonant frequency, but two new peaks spaced approximately equally on either side, which are about the same amount of power transfer that we had at critical coupling. Moving out past the peaks, we find power transfer dropping off again; after it passes the resonant-frequency level, it drops rather rapidly. This is the "overcoupled" condition.

By holding the product *k*Q to 4 or less, the "top ripple" or difference between resonant-frequency power level and peak power level can be held to less than 6 db. In the design procedure outlined here, a choice of 0.8 db, 3 db, and 6 db is give for top ripple.

The more violent the top ripple, the narrower will be the out-of-band region. Also, the higher the operating Q must be. In practice, the top rippple of 0.8 db will usually provide plenty of out-of-band rejection while keeping the passband reasonably flat and permitting reasonable values of Q in the tanks. For these reasons, it's recommended that this value of top ripple be used unless there's a special need for one of the other values.

With the circuit of Fig. 1-F, as coupling is increased the lower peak tends to stay fixed in one spot while the upper peak moves higher in frequency. This requires that tune-up of such a circuit be done at a frequency *other*

than the generally used mid-frequency.

At this point, we're ready to sneak a look at the design procedure. Basically, we're going to pick a working Q to suit the passband we want, then adjust the value of *k* to put the passband limits at the right place. It's quite possible for this procedure to dictate an impossibly high value for Q, or an impractically low value. In such a case, you may have to modify either your passband or the level of top ripple.

For the same passband, higher top ripple and higher Q go together. If you design for 0.8 db top ripple and find yourself coming up with a Q of 4.3, you can move to 3 db top ripple and the required Q will increase. Similarly, if you're designing for 6 db top ripple and need a Q of 10,000, moving to 0.8 db top ripple may bring the Q value down to a reasonable point.

For a fixed amount of top ripple, a narrower passband requires higher Q. If Q is too low, you might try settling for a little less bandwidth. If too high, expand the bandwidth.

To use the design procedure, now, we must first decide upon our frequency limits, the amount of top ripple, and the tube operating conditions (plate voltage and current at resonance).

Use Chart 1, the frequency limits, and the top-ripple specification to determine required tank Q. Then use the Q and Chart 1 again to determine *k*. Finally, with Q and the frequency limits, determine the "tune-up frequency". In the rest of the procedure, when solving for reactance, this will be the frequency to plug into the formula.

Now, with Q and *k* settled, drag out a big sheet of paper and some sharp pencils. We have some arithmetic to do. There are at least six steps—usually eight are required:

1—Calculate effective load resistance R_1 from the tube operating conditions and the formula $R_1 = Eb/2Ib$.

2—Calculate X_c and X_1 from Q and R_1 by using the formula $X_c = X_1 = R_1/Q/$.

3—Calculate the value of L from X_1, tune-up frequency, and the formula $L = 6.28\ f/X_1$. This is a final value.

4—Calculate C from X_c, tune-up frequency, and formula $C = 1/(6.28\ f\ X_c)$. This is an intermediate value only.

5—Calculate C_a from *k* and C, and the formula $C_a = (1 + k)C$. This is a final value, including tube and stray capacitances.

6—Calculate C_c from C_a and *k*, using formula $C_c = C_a/k$.

For those applications in which the input and output see equal values of load resistance, the design is complete at this point. However, in most cases the output load resistance is much less than the input R_1; in such cases, matching is most easily done by capacity taps, and the values of capacitors making up the tap point must be calculated.

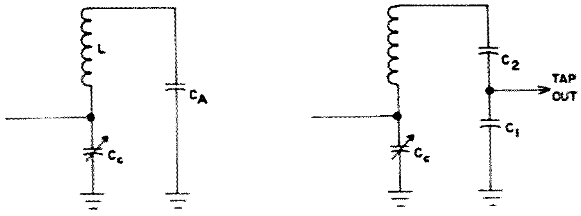


FIG. 2

Output tap

These calculations are done using reactance rather than capacitance values, and the reactances are then converted back to capacitance using the formula of step 4 above. The two reactances which must be calculated are X_1 and X_2 (See Fig. 2).

To find these reactances, we must know the resistance of the load, the R_1 for which we designed the circuit, and the reactance of C_a. The only one of these three which we may not have readily available is the resistance of the load.

If the load happens to be an antenna, its resistance will be known. If it is, however, the grid of a following Class C amplifier stage, we're going to have to find out what the average resistance is. It *won't* be simply the value of the grid leak, though, since the grid draws some power whenever grid current flows.

The simplest way to determine this resistance is to measure the RMS value of the RF grid voltage, and the grid current, then use Ohm's Law in its $R = E/I$ version to get the effective load resistance. RF peak voltage will be approximately equal to the actual DC bias voltage developed; you can take the developed bias and the DC grid current, and you won't be too far wrong. Thus if the next stage develops 90 volts of bias with 3 MA of grid current, the effective resistance is about 30,000 ohms.

Now that we have all three factors known, let's figure the reactances involved. X_1, the reactance of C_1, must be equal to X_{Ca} times the square root of the ratio (R_{next}/R_1). X_2 on the other hand is merely X_{Ca} minus X_1.

If a 50-ohm antenna is to be tapped onto a coupler designed for an R_1 of 2500 ohms, in which the reactance of C_a is 18 ohms, then X_1 would equal 18 times the square root of 50/2500, or 18 times 1/7.1. This comes out to 2.54 ohms. X_2 would then be 18 minus 2.54,

or 15.46 ohms.

Should the actual load resistance offered by the next stage be larger than the value of R_1 for which you designed the coupler, then a shunt resistor must be added to reduce the total load resistance to design value. The value of this shunt resistor is found by multiplying the actual load resistance times R_1, then dividing the product by the difference between actual load and R_1. If actual load is 30,000 ohms and R_1 is 2,500 ohms, then R_{shunt} would be 30,000 × 2,500/27,500, or 2,730 ohms. A 2700-ohm unit would be suitable.

However in this case most of the power will flow through the resistor, rather than the true load. The ratio of power in the two branches will be the same as the inverse of the ratio of their resistances; if 3.27 watts is flowing in the output of the previous example, 3 watts will be going through the resistor and only 27/100 of a watt will go to the actual load. There's no way around this drawback; the only thing you can do is to change operating conditions of the next stage so that its input resistance is more close to the design value of R_1. For instance, grounded-grid amplifiers always have low values of input resistance.

To see how all this comes together in practice, let's work out an example now. Let's assume that we have a 6146 which we're going to use in a 60 watt (or so) exciter, and we want output essentially constant over the range from 48 to 54 mc. We intend to run 600 volts to the tube, at 120 ma, and it's going to feed a 50-ohm load which will be an antenna from 50 to 54 mc and a flat link to a triper in the 48-49.333 mc region.

We said output should be "essentially constant" so let's use the values for a top ripple of 0.8 db. This varies only about 10 per cent over the passband. With our frequency limits set at 48 and 54 mc, and top ripple set at 0.8 db, Chart 1 gives us a value for Tank Q of ¾ times (Fh + Fl)/(Fh–Fl). This comes out to be ¾ of 54 + 48/54–48, or ¾ of 102/6, and a bit of cancellation brings us to 51/4. The slide rule solves this for us and yields a Q value of 12.75.

Now let's get *k*. Chart 1 tells us it's 1.4/Q, so back to the slide rule to find that 1.4/12.75 equals 0.1105.

Now to our six steps of calculation. R_1 comes out to 600/.240 or 2500 ohms. X_c and X_1 come out to 2500/12.75 or 197 ohms. To get L we must know the tune-up frequency, which in our case is 52–52/25.5) or 52–2.04, or 49.96 mc. Plugging this into our equation for L gives 6.28 × 49.96/197, or 0.62 microhenries.

Using X_c and tune-up frequency we find that C is equal to 1/6.28 × 49.94 × 197, or 16 mmf. C_a equals 1.1105 times 16, or 17.8 mmf, while C_c equals 17.8/0.1105 or 161 mmf.

Since we're feeding a 50-ohm load and R_1 is 2500 ohms, we must calculate X_1 and X_2 also and obtain from them values for C_1 and C_2. For X_1 we plug in values: reactance of C_a is 176 ohms at tune-up frequency, so X_1 equals 176 times $(50/2500)^{1/2}$ or 176/7.1, which comes out to be about 24.8 ohms. X_2 is simply 176 minus 24.8, or 151.2 ohms. Capacitances equal to these reactances at tune-up frequency are 127 mmfd for CI, and 20.8 mmfd for C2.

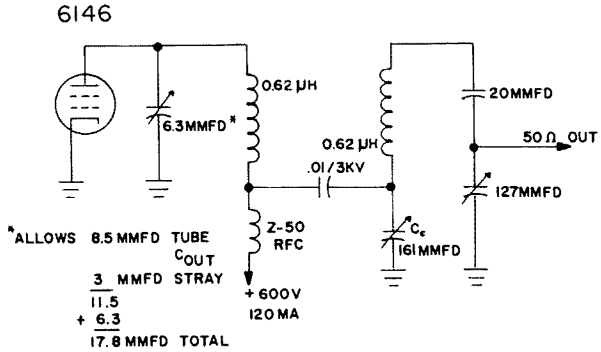


FIG. 3

Sample design

The completely designed circuit appears in Fig. 3 with all component values marked.

Once designed, a bandpass coupler of this type is simpler to tune up than a conventional single-tuned circuit. Start by setting all adjustable elements as closely as possible to the calculated values, with the exception of C_c. This one should be set to maximum, and then shorted out with a very short jumper wire as well. Feed in some drive at tune-up frequency, and adjust either C_a or L (on the input side) for the best possible dip. This should be a very small adjustment; it's better to adjust C_a if you're reasonably certain that L is at the design value, since C_a is affected by stray capacitance which cannot be estimated accurately. The dip should be deep and you should find no trace of output on the far side of the coupler.

Now unshort C_c but don't change any other settings. Adjust the output-tank tuning in the same manner for a peak in output. C_2 is the one to adjust on this tank if you're reasonably sure of the setting of its inductance.

Next step is to "rock" the drive frequency by about 10 per cent either way to make sure that you have only one peak in the output, and that it's at tune-up frequency. If you have two peaks, add some temporary shunt capacitance across C_c and repeat the output tank tuning adjustment. The dip in plate current should still be fairly sharp and output should be very small.

Now return to tune-up frequency and reduce the setting of C_c until plate current reaches design value. Rock drive frequency across the entire passband. You should have a peak at tune-up frequency and a slight (about 10 per cent) dip in output at the frequency midway between band limits. Another peak should be present as far above mid-frequency as tune-up frequency is below that point, and output at the band limits should equal that at mid-frequency. If all these conditions are met, tune-up is complete.

However, don't be disappointed if it doesn't quite work out this way first time around. As we said at the start, some cut and try is still necessary.

If the peaks are less than 10 per cent above mid-frequency output and the output at the band limits is down below that at mid-frequency, coupling is too loose. Reduce the setting of C_c a bit more until output at both band limits and at midfrequency are all equal. Output at tune-up frequency should then be 0.8 db higher.

If the peaks are too high and the band is too wide, the coupling is too great. Increase the capacitance of C_c and recheck.

If peaks are too high and the band is too narrow, the Q of the circuit is too high and the coupling is also off. Increase coupling until plate current is correct. If band is still too wide and peaks too violent, return to original settings and shunt both tanks with equal-valued resistors to reduce Q a bit. This is pure cut-and-try, but start with high-valued resistors and work down until things smooth out. You really shouldn't run into this problem unless your slide rule slips a cog (as ours does now and then), in working the arithmetic.

Peaks too low and the band too wide indicate Q lower than design value. Increase circuit capacitance at C_a and C_2 and retune L to resonance. This will require reworking the design equations if the changes are very large.

While our entire approach in this article has been toward use of bandpass couplers in transmitters, they are equally applicable to receivers, especially in the signal-frequency stages and *if* output stages of vhf converters. The same principles apply except that the value of R_1 must usually be fixed by a composition resistor across the tank on each side. This re-

sistor appears in parallel with the output impedance of the tube on the plate side and with the input impedance of the following tube—and at vhf input impedance of some more popular tubes can get below 1000 ohms. Best bet here is to shoot for a practically realizable impedance level; this is usually found with a top-ripple factor of 0.8 db. Though out-of-band rejection won't be quite as good as with higher top-ripple factors, it will still be better than with single-tuned circuits. For instance, a 50-54 mc bandpass coupler with 0.8 db top ripple is only 15 mc wide (total) at the −20 db points, and if three of these couplers are cascaded as they would be if used between antenna and first rf, first rf and second rf, and second rf and mixer, then by the time signals reach the mixer the bandpass will be 60 db down 7½ mc either side of 52 mc. This is more than adequate for good image rejection if the output *if* is at least 4 mc or more.

For more information on double-tuned circuits, see references below. . . . K5JKX

References

F. Langford-Smith, **Radiotron Designers Handbook**, RCA, pages 412 through 422.

IT&T, **Reference Data for Radio Engineers**, 4th edition, pages 236 through 246.

F. E. Terman, **Electronic and Radio Engineering**, McGraw-Hill, 4th Edition, pages 63 through 74.

Propagation Chart

EASTERN UNITED STATES TO:

GMT -	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	7	7	7	7	7	7	7	7	14	14*	14
ARGENTINA	7#	7#	7	7	7	7	14	14	21	21	21	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7#	14	14	14	14*	14*
CANAL ZONE	7	7	7	7	7	7	14	14	21	21	14*	14*
ENGLAND	7	7	7	3.5*	3.5*	3.5*	14	14	14*	14	7	7
HAWAII	14	7#	7	7	7	7	7	7	14	14*	14	14
INDIA	7	7	7#	7#	3#*	3#*	7#	14	7*	7#	7	7
JAPAN	7#	7#	7#	7	7	7	3.5*	7	7#	7#	7#	14
MEXICO	7	7	7	7	7	7	7	14	14	14*	14*	14
PHILIPPINES	14	7#	7#	7#	7#	7	7	7	7	7#	7#	7*
PUERTO RICO	7	7	7	7	7	7	14	14	14	14	14	7*
SOUTH AFRICA	7	7	7	7	7#	7#	14	21	14*	14	14	7#
U. S. S. R.	7	7	3.5*	3.5	3.5	3.5#*	7#	14	14	7#	7#	7
WEST COAST	14	7	7	7	7	7	7	14	14	14*	14	14

Good: 3-4, 8-9-10-11, 14-15-16-17, 20-21-22-23
Fair: 1-2, 5-6-7, 13, 19, 25-26, 31
Poor: 12, 18, 24, 27-28-29-30
Es: 1, 6, 10-11, 20-21-22-23, 31 and Jan 1-2
(High MUF and/or freak conditions)

CENTRAL UNITED STATES TO:

ALASKA	14	7	7	7	7	7	7	7	7	14	14*	14
ARGENTINA	7#	7#	7	7	7	7	14	14	21	21	21	14
AUSTRALIA	14	7#	7#	7#	7#	7#	7#	7#	14	14	14*	14*
CANAL ZONE	7	7	7	7	7	7	7*	14	21	21	21	14
ENGLAND	7	7	7	7	3.5	3.5	7	14	14*	14	7	7
HAWAII	14	7#	7	7	7	7	7	7	14	14*	14*	14
INDIA	7	7	7#	7#	7#	7#	7	7*	7*	7#	7#	7
JAPAN	14	7#	7#	7	7	7	7	7	7	7#	7#	14
MEXICO	7	7	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	7#	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	14	14	14*	14	14	14
SOUTH AFRICA	7	7	7	7	7#	7#	14	14*	14*	14	14	14
U. S. S. R.	7	7	3.5*	3.5	3.5	3.5#	3.5#*	14	7#	7#	7#	7

J. H. Nelson

WESTERN UNITED STATES TO:

ALASKA	14	14	7	7	7	7	7	7	7	14	14*	14*
ARGENTINA	14	7#	7#	7	7	7	7#	14	21	21	21	21
AUSTRALIA	21*	14	7#	7#	7#	7#	7#	7	14	14	14	21
CANAL ZONE	14	7	7	7	7	7	7	14	14*	21	21	14*
ENGLAND	7	7	7	7	3.5	3.5	7	7	14	14	7	7
HAWAII	21	14	7	7	7	7	7	7	14	14*	21	21
INDIA	7*	7*	7#	7#	7#	7#	7	7	7	7	7#	7#
JAPAN	14*	14	7#	7#	7#	7	7	7	7	7#	7#	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14*	14	7#	7#	7#	7	7	7	7	7#	7#	14
PUERTO RICO	7	7	7	7	7	7	7	14	14	14	14*	14
SOUTH AFRICA	14	7	7	7#	7#	7#	7#	14	14	14*	14	14
U. S. S. R.	7	7	7	3.5	3.5*	7	7	7*	7#	7#	7#	7#
EAST COAST	14	7	7	7	7	7	7	14	14	14*	14	14

Very difficult circuit this hour.
* Next higher frequency may be useful this hour.